Profit

by

PRECISE

Control

of

Atmospheric Conditions

Sturtevant

AIR CONDITIONING SYSTEMS

promote *improved quality, continuous production,* and *reduced wastage* by consistently providing

- CONSTANT TEMPERATURE AND HUMIDITY
- HIGH EFFICIENCY AIR FILTRATION
- DRAUGHTLESS AIR MOVEMENT

for the processing or storage of materials and products sensitive to variations in temperature and humidity or easily damaged by airborne impurities.

•

Our publication V4303 gives general particulars and will be sent on request.

STURTEVANT ENGINEERING CO. LTD
SOUTHERN HOUSE, CANNON ST., LONDON E.C.4.

AUSTRALIA
STURTEVANT ENGINEERING CO. (AUSTRALASIA) LTD
400 SUSSEX STREET, SYDNEY, N.S.W.

Manufacturing Chemist

Editor: W. G. Norris

Vol. XXXI, No. 6 JUNE, 1960

Topics and Comments 229

Monopoly hunters misled; Royal jelly; Evaluating tranquillisers; Bulwark of East Germany; The other side of the curtain; O'erpowering perfumes; Railway chemistry; Data double quick; A manageable organo-P.

DRUGS VERSUS CANCER

Aspects of the Chemotherapy of Cancer—1 233
By Walter Davis, PH.D.

Viral and Immunological Aspects of Cancer 238
By D. A. Darcy, M.A., D.PHIL.

The Sulphosuccinate Wetting Agents 242
By J. S. Stanley, B.SC., PH.D.

Flow Measurement and Control Equipment 245
By A. Linford, B.SC., A.M.I.C.E., A.M.I.W.E.

The SKF Laboratories at Welwyn 249

Memoirs of an Industrial Chemist.—3 Recruiting Research Talent 250
By M. L. Burstall, D.PHIL.

Progress Reports

Cosmetics and Toilet Preparations 254
By W. W. Myddleton, D.SC.

Disinfectants and Disinfection 257
By A. H. Walters, F.I.M.L.T., M.R.S.H., M.I.BIOL.

Fertilisers and Plant Nutrients 259
By D. P. Hopkins, B.SC., F.R.I.C.

REGULAR FEATURES: PLANT AND EQUIPMENT 261 BOOKS 263 • CHEMICALS IN THE COMMONS 265 • PACKAGING 266 • NEWS 267 • PEOPLE 269 • TECHNICAL PRESS REVIEW 271 • MEETINGS 271 • NEWS FROM ABROAD 273 CHEMICAL MARKET 274 • NEW PRODUCTS 275 • NEW TRADEMARKS 276 • NEW PATENTS 276 • NEW COMPANIES 276 • SIXTY-FIVE YEARS AGO 276

Subscription Rates: One Year £2; Three Years £5.

© LEONARD HILL LIMITED

A Publication of the Leonard Hill Technical Group:
Leonard Hill House, Eden Street, London, N.W.1 (Euston 5911).

Cables:—Abroad: Lenardil London. Inland: Lenardil Norwest London.

U.S.A.: 1214 Villa Drive, N.E. Atlanta, Georgia; 2515 Beverly Blvd.: Los Angeles 57, Calif. (Dunkirk 1-2241); 121 Ward Parkway, Kansas City, 12, Mo.; 501 Fifth Avenue, Room 611, New York 17, N.Y. (YUkon 6-2477); 681 Market Street, San Francisco 5, California (Exbrook 2-2612); 332 West Harrison St., Oak Park, Illinois (COlumbus 1-7906); 1501 Euclid Bldg., Room 426, Cleveland 15, Ohio (TOwer 1-2280); ITALY: Via Filippo Turati 3 (Palazzo Giardino), Milan; FRANCE: 63 Avenue Kléber, Paris XVI^{e} (Pasy 31-30); SWEDEN: Tunnelgate 19B, Stockholm; DENMARK: Palaegade 7, 3 Sal., Copenhagen K: GERMANY: Börnestrasse 41, Frankfurt/Main.

GLASS CONTAINER MANUFACTURERS INTRODUCE

FREE

Container-acceptance Testing Service

A new service designed to help Packers

Britain's Glass Container Manufacturers have incorporated the most advanced market testing techniques in a new range of services to be offered to the packing industry. This is the Container-acceptance Testing Service. It has been set up to meet the very real need of Packers for adequate facilities to test their new packs before going into mass production. Any new glass pack may now be tested in any one, or all four, of the following progressive stages:– 1 Design Preference Testing, 2 Container In Use Testing, 3 Shelf Testing, 4 Area Test Marketing.

Free Service

Because the glass manufacturers believe that this service should be used as widely as possible, all the facilities under headings 1, 2 and 3 are offered as a *free* service to the packing industry. The only cost to the Packer will be in the supply of goods, containers and such items as labels and transport. In the case of Area Test Marketing Schemes however, a nominal charge will be made for planning the operation.

Security

Where any of these tests are carried out on new products, the whole operation can be executed with absolute security. Packers can have complete anonymity by employing one of the several brand names that have been registered especially for this purpose.

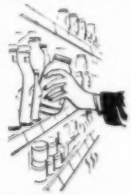
If you would care to have further details of this service, please do not hesitate to ask, whether your interest is immediate or long term. Your Glass Container Manufacturer will be happy to discuss your problem and to help you in any way. Details of the scheme have been published as a booklet, copies of which are available on request from your Glass Manufacturer or from the Federation.

1 Design Preference Testing

Facilities are available to test the appeal and acceptability of new container designs on a consumer panel of 400 households in London, Birmingham, Manchester and Glasgow. From this panel a balanced sample can be drawn to match the known, or estimated, consumer market for the product. The panel's reactions to the design will be recorded, analysed and presented to the Packer as a report and recommendation.

2 Container in Use Testing

Testing the consumers' attitude towards the new pack can be carried a step further than discovering the appeal of the design only. Any new glass container and the product for which it is designed can be tested in actual home use by the consumer panel. Their experience of how the pack measures up to the requirements of use in the home will be recorded, analysed and presented to the Packer as a report and recommendation.



3 Shelf Testing Service

The sales appeal of a new design can be tested under actual store conditions. The pack will be placed on the shelves or counters of a number of self-service or other stores in main population centres. The speed and volume of off-take will be recorded and analysed by class of store and locality. The packed product may be tested either alone or against any alternative design or other existing pack.

4 Area Test Marketing

Because the pack and product testing service is so closely associated with marketing, it was felt that facilities to link the two operations would furnish Packers with a valuable additional service. To this end an expertly staffed marketing service has been established which will plan, organise, and, if desired, execute test marketing campaigns in their entirety, on behalf of any Packer launching new glass packed products.

SEE HOW GOOD THINGS ARE IN GLASS

THIS IS AN ADVERTISEMENT OF THE GLASS MANUFACTURERS' FEDERATION · 19 PORTLAND PLACE · LONDON W1 · LANGHAM 6053

TOPICS AND COMMENTS

Monopoly hunters misled

THE watchdog of public expenditure, the Comptroller and Auditor General, in his latest report, criticises an unnamed chemical manufacturer for insisting on what he considers exorbitant profits from a contract with the Atomic Energy Authority for the supply of a special chemical. The firm asked for a 17% return on the capital employed in producing the chemical in the first year, rising to 45% in the fifth and last year of the five-year contract. Superficially this high return seems to justify the Auditor General's complaint. But the facts give a different picture. Apparently the firm is reluctant to continue with the contract because it ties up capital and plant in an esoteric product for which there is only one customer. When the A.E.A. asked the firm to expand capacity it requested the Authority to put up the extra capital necessary. This was refused and lengthy negotiations ensued. The firm insisted that it should obtain the same return on the extra capital employed as it would have earned if the funds were used in the way the directors wanted, and not the way the A.E.A. wanted. The final solution was the agreement criticised by the Auditor General.

As mentioned in our Parliamentary report (p. 265) a Labour M.P. has asked the President of the Board of Trade to refer the case to the Monopolies Commission and the President has undertaken to consider the matter when a full report is available. He should not bother himself with the matter for the view of every fair-minded person must be that the firm is quite justified in the stand it has taken. Why should it be compelled to use its funds for the benefit of a single customer in a way which will not earn the profit they would otherwise bring? The suggestion that the Monopolies Commission should investigate the matter is particularly absurd in view of the firm's disinclination to continue with the contract. The Auditor General has set the witch hunters of the Opposition on to a false scent.

D.S.I.R. research grants

IN the first year of its second five-year plan the D.S.I.R. has greatly increased its grants for research and training at universities and technical colleges. The 1959 report, published on May 26, shows that during the year over 360 applications for research grants were received and that 295 were awarded. The cost is £2,232,000 against £1,090,000 in the previous year. Chemical research will benefit by the award of two grants, each over £20,000, for the purchase of the Metropolitan-Vickers mass spectrometer MS9, an instrument—still under development—which will distinguish between simple ions of the same integral mass but differing constitution. These spectrometers will be used for molecular studies by Prof. Ingold at University College, London and by Dr. Reed at Glasgow University. Prof. Jones of Queen Mary College, London, has received £13,000 for spectroscopic work at extreme infra-red wavelengths.

Royal jelly

THE recent history of royal jelly, the food which makes a queen bee out of a fertilised egg which would normally become a worker, is a sad commentary on human gullibility. The March issue of *Which?* contains a withering commentary on the claims made for this material, and is based on the critical reviews in the international journal *Bee World* (1955, **36**, 3-13, 21-22; 1958, **39**, 254-264, 277-286). Of the seventeen cosmetics and ten preparations for internal use which are listed, not one is recommended. The Consumers' Association (publishers of *Which?*) is to be praised for publishing the facts, but one is left with an uneasy feeling that it is beating the air.

Even sensible people sometimes get a kick out of buying things that, soberly considered, are not worth the cost. Man's need to throw his hat over the moon sometimes may be just as important as his need for vitamins and minerals, but is far less understood. If the gullible woman's dream of eternal youth is disappointed, at least she had the dream. Royal jelly is not known to be harmful to normal people in the minute doses found in these preparations, and if they fill some people's need for glamour and mystery, are they so harmful?

Evaluating tranquillisers

A PHARMACOLOGIST at the Stanford Research Institute, Menlo Park, California, has devised a method for evaluating the mental effects of a drug by employing the responses of mice to sound-induced stress. He is Nicholas Plotnikoff, who is working on psycho-pharmacology. He is using his method to evaluate potential tranquillisers and stimulants.

Mice in a large or open-end container show little alarm at the ringing of a loud electric bell. Put them in a small box with no apparent means of escape, however, and the bell causes them to run about frenetically and leap into the air with wild contortions. Within a short time, this activity culminates in a convulsion. This reaction is labelled an audiogenic seizure.

Plotnikoff finds that the well-known tranquillisers, while having no effect on mice exposed to electro-

shock, will block audiogenic seizures. Likewise, a new chemical that might be a stimulant tends to hasten the onset of seizure. Thus, by giving mice varying concentrations of a chemical and tabulating resultant behaviour differences, the potential "psycho-pharmacological" drug can be evaluated.

In addition to behaviour reactions to sound, other members of the psycho-pharmacology team are concerned with the chemical changes in a mouse's brain during a seizure. They then attempt to define the effect of potential drugs on this "neurochemistry". An interesting sidelight which Plotnikoff plans to investigate in the future is the resemblance of the audiogenic seizure to human panic reactions. For example, eye-witnesses of a famous circus fire reported that the crowds inside the tent did not rush for the exits and safety so much as they ran around wildly in circles—much the same as the mice do when they hear the bell.

Plotnikoff plans future experiments in which the mice are enclosed but have a means of escape known to them. He also is interested in observing the possible differences between a single mouse exposed to the bell and group behaviour resulting from auditory stress.

Bulwark of East Germany

THE chemical industry of East Germany, developed intensively by the Nazis as a war industry, remains today one of the most important in Europe. The present regime has recognised the importance of the industry as a bulwark of the national economy and has built on the foundations of the Nazis so that today the industry employs just over 250,000 people, nearly 10% of the country's total industrial manpower. Its output is worth over 8,000 million marks p.a., almost 15% of gross industrial production and about 9½% of the gross national product.

Relatively little is known about this important industry in western countries, so we welcome the enterprise of Joseph Crosfield and Sons Ltd. in compiling a statistical profile of the industry. The book runs to 145 pages and it is the third volume in a series of studies of the East European chemical industry being produced by Crosfields. The sources used are entirely Communist ones and the information has been tabulated in admirable order with the minimum of comment. Information as recent as November 1959 has been included.

Most of the chemical industry is state-owned, being controlled either centrally or locally in units called VEB's (volkseigener Betriebe). There are still privately owned factories, however, which fall into two groups: those in which the owner works under the direction of the government, and those which are true private firms. Private industry does not have an easy time and lacks the advantages of the state industries in obtaining supplies and in marketing its goods. Of the 250,000 workers in the chemical industry, only 20,000 work in truly private firms and just over 5,000 in semi-private firms.

Private enterprise seems to be relatively flourishing in the pharmaceutical sector of the industry; of the 142 pharmaceutical enterprises, 91 are private and 6 semi-private. But the private firms employ only 3,600 of the 15,283 workers in pharmaceuticals, so it is clear that they are very small establishments. In fact they contribute only 70 million marks to the total pharmaceutical output of 420 million marks.

Before the war Berlin was the only real centre of pharmaceutical industry in East Germany. Since the war existing factories in Berlin have been enlarged, *e.g.* Schering, Grunau Chemical Works and Kalichemie, and new factories have been built at Dresden, Dessau and Jena. Jenapharm, Jena, is particularly important. Built originally to make antibiotics, it now makes penicillin, streptomycin, anti-TB drugs, anæsthetics and vitamins. East Germany now claims to be self-sufficient in pharmaceuticals and is, indeed, a considerable exporter. Production in 1958 included 464 million units of insulin, 3.8 million mega units of penicillin (a slight reduction compared with 1957), 3,340 kg. of streptomycin base, and 2,412 kg. of chloramphenicol. Other figures given in the book (for 1957) are 30,636 kg. amino-phenazone, 169 tons of sulphonamides, 266,778 kg. of phenacetin and 72,755 kg. of caffeine.

The East Germans trade mainly with Russia and other Communist countries. Russia is a major supplier of chemical raw materials. There is a pipeline for oil deliveries from Russia which are due to quadruple by 1965 to a total of 4.8 million tons to supply East Germany's growing petroleum chemicals industry.

The other side of the Curtain

IN CONTRAST to the achievements in East Germany, the pharmaceutical industry on the other side of the Iron Curtain is much more impressive. Including West Berlin, output is worth about DM 2,000 million p.a., perhaps a little more than the 1959 output of the U.K. pharmaceutical industry. Exports amount to about 25%, although it must be remembered that in some cases the shipment of goods a few miles across a frontier constitutes exports.

Last month, in company with a small party of members of the Fine Chemicals Group of the Society of Chemical Industry, we inspected four important West German chemical firms, three of which produce drugs. In Frankfurt-on-Main we visited Farbwerke Hoechst, in Darmstadt E. Merck A.G., and in Leverkusen Farbenfabriken Bayer. Each of these factories lies on the western borders of Germany and each suffered severely during the war. Accordingly, much of what we saw was of new or fairly recent construction. Vigorous expansion is the dominant recollection of our visits. In each factory new buildings were being erected, some on new sites and others on sites being cleared by the demolition of old buildings. Much of the equipment we saw was of the latest design, particularly the beautifully equipped ampoule filling department of

E. Merck, the antibiotics fermenters in the Hoechst research laboratory, and some of the packaging machinery (*e.g.* electronic tablet counters) at Bayer. Some, on the other hand, was somewhat ancient. For instance, we saw a battery of tableting machines which, we were told (and believe), were built in the nineteenth century. It seems extraordinary that equipment should be kept in service for so long.

Bayer has just had a very successful year. Turnover increased by 22·3% to DM 2,460 million and net profits went up by DM 13 million to DM 105·6 million. The total of employees has increased by well over 20,000 in the past nine years and now stands at 55,100. Hoechst has also done well; in 1959 turnover increased by 17·6% to DM 2,200 million and profits from DM 64·7 million to DM 86·2 million. The number of employees has increased to over 45,000.

Both these companies, of course, were formerly divisions of I.G. Farbenindustrie. So was the fourth company we visited, Chemische Werke Hüls of Marl. This firm employs 15,000. If the 50,000 or so employees of the fourth I.G. successor company, Badische Anilin und Soda Fabrik, are reckoned, the four former I.G. companies now employ about 165,000 workers, thus accounting for a substantial portion of the West German chemical industry.

However, it is misleading to group the companies together because we were assured that they are strong competitors of each other. Certainly in the pharmaceutical field Bayer and Hoechst are competitive in such products as antibiotics, sulphonamides and analgesics.

The four companies we visited are spending lavishly on research. Bayer, for instance, spent 4·5% of their turnover (about DM 111 million) on research and development last year and now employ 6,674 people on research. About 24% of their turnover is accounted for by products resulting from their own research. Hoechst spent about DM 100 million on research and development last year, also about 4·5% of their turnover. They claim that 20% of their sales consist of products they have discovered in the past five years. E. Merck, although a smaller company, invests substantially in research. One of the new buildings at Darmstadt is the pharmacology department equipped with the latest paraphernalia of the pharmacologist, including excellent facilities for animals. Also new is the control laboratory block where all raw materials and finished products are checked and which is called " the conscience of the factory."

These are the facts and certainly our impressions were that the Federal German chemical industry is lively and buoyant. The factories we saw are large, well-planned and in a ferment of new construction. The industry has been impressively re-established as a world leader in chemicals and drugs. In 1959 its turnover increased by 14% to DM 20,500 million and it is now the second largest industry in Western Germany. We hope to publish a fuller report of our trip in a later issue.

O'erpowering perfumes

THERE are many industrial odours and several methods of dealing with them to prevent them being a public nuisance, but we have yet to hear of a means of neutralising perfumery factory odours which is both effective and economical. Admittedly the problem is uncommon, but it is a very real one for perfumery factories in towns, particularly if they are near residential areas. Absorption by activated carbon is an obvious possibility, but this is likely to be expensive because of the large volume of vapour involved and because of the difficulty of regenerating the carbon. Ultraviolet lamps are not likely to be helpful because the smell is not of bacterial origin. Combustion of the vapours might be considered, but the maintenance of the requisite temperature could make the process uneconomical. Perhaps a catalyst might be tried; we understand that a catalytic process for treating the exhaust gases of petrol and diesel engines is being studied. If any reader has information on this interesting pollution problem we should like to hear about it.

Railway chemistry

SOME people are sentimental about railways. Hence the rumpus when British Railways threaten to close an uneconomic branch line or a station that no longer serves a useful purpose. Unfortunately sentiment is a luxury the railways cannot afford, so the closures go on, up and down the country. Nothing looks more desolate than a disused railway, so the best way to obliterate the painful sight from eye and mind is to put it to some other use. Thus, rail tracks are being turned into roads. But stations pose a different problem. What can one do with a disused railway station? A warehouse? Perhaps. But hardly a dance hall and certainly not a cinema. Cinemas are being turned into warehouses and bowling alleys.

British Railways themselves have given at least one good example of what to do with an old station. It used to be Alexandra Palace at Muswell Hill on the northern heights of London. Now it has vanished and in its place stands a block of laboratories and offices for B.R.'s Chemical Services departments. Now that in itself will surprise people who think that the only connection between railways and chemistry is a tank car load of chlorine or a wagon load of soda ash. In fact, when the British Transport Commission took over the assets of the railways they inherited about a dozen chemical laboratories, and since 1951 they have been co-ordinating their work. At Muswell Hill is the first of the new chemical centres which the Commission is setting up to serve all parts of the railway system. It accommodates the headquarters staff of the Chemical Services, the London Area Chemical Laboratory, the Building Materials Laboratory and the Corrosion Laboratory.

The London Area laboratory has a wide range of activities. It makes routine tests of materials other than textiles; investigates the causes of damage to goods in transit and accidents involving dangerous

goods; does laboratory investigations for the Comission's police force; examines water supplies, fuel and foodstuffs; and controls chemical manufacturing processes such as oil blending, train lighting battery manufacture, electroplating and research problems arising therefrom. It is certainly unusual to think of the railways as chemical manufacturers.

The work of the Corrosion laboratory ranges from studies of corrosion of structures and equipment to investigation of corrosion in the cooling systems of diesel locomotives. The Building Materials laboratory tests new materials and helps to put right defects in existing structures, seeking to improve acid and corrosion resisting cements and other materials.

The work of the railway chemists can do much to improve the efficiency of our much criticised railways. The new building at Muswell Hill will certainly be much more valuable than the old station that once stood there. Let us hope this will console the people who grieve over its disappearance in the cause of progress.

Data double quick

MANY chemical research laboratories are trying to mechanise their information systems in order to cut out the waste of skilled manpower now taken up by laborious searches of the literature, card indexes and other data collections. Everyone knows that a quick and reliable method of getting at data already recorded could save not only hours and days of searching but also, in the event of failing to locate the information, days spent in duplicating experiments already carried out.

At the University of Hawaii a method has been developed for locating data about organic compounds with similar functional groupings by means of punched-card techniques on a standard I.B.M. sorting machine. E. G. Smith, who describes the system in *Science* (1960, **131,** 142), says that the need for expensive and complicated machines has been avoided by a judicious combination of machine sorting (made possible by a special searching code) and visual inspection (made possible by the intelligible nature of the Wiswesser notation). The Wiswesser notation gives unique patterns of letters and numbers for each different structural formula, so there is only one place to look in an alphabetically arranged list of notations for any given compound. It is reputed to be intelligible at sight to any chemist who will learn about a dozen new symbols to supplement the old and familiar ones and some of the essential rules for using them. It is also intelligible to punched card machines because it does not use any symbols that cannot be expressed on existing machines. It is so concise that at least 98% of the organic compounds of known structure in such a compilation as "Heilbron" can be expressed in notations which require less than half the space on a single I.B.M. card. The rest of the card can then carry other information about the compound, and the resulting single card for a single compound greatly simplifies the machine problems in finding and reproducing desired information. The problem of locating data about a specific compound is thus solved directly by the notation itself. Searching for groups or compounds with the same functional groups is more difficult, however, since symbols for a particular functional group occur at any point in the line-formula notation and so may occupy any column or group of columns in the part of the I.B.M. card punched with the notation. So an additional code is used to find the cards carrying particular symbols, preferably by the use of simple and least expensive single-column sorting machines.

The system has been tried out on a punched card file of 50,000 organic compounds and it has located compounds with similar functional groups in a matter of minutes. A semicarbazone search produced cards for 1097 semicarbazones in 8 min., with only two unwanted cards. A more complex search produced simultaneously the cards for 420 phenylhydrazones, 50 *p*-bromophenylhydrazones, 230 *p*-nitrophenyl hydrazones and 250 2,4-dinitrophenylhydrazones, each in separate alphabetical groups ready for listing, in 25 min. of machine sorting and 55 min. of visual inspection. As a by-product of this search, the machine-sorts to remove thiosemicarbazones (by sorting for S, column 5, punch position 3 and Z, column 3, punch position 9) and phenylsemicarbazones (by sorting for MV, column 4, punch position 9) gave "pure products" in each of these categories without "contamination" either from compounds in the four groups being sought or from other compounds.

There are, of course, other location and retrieval systems and for some time we shall no doubt hear of their respective merits and drawbacks. It is good that so much interest is being taken in this important problem of getting at the vast stores of information built up over the years.

A manageable organo-P

A GRAVE disadvantage of organo-phosphorous insecticides—acute mammalian toxicity—has been removed with the introduction in Britain of *Nankor* by Dow Agrochemicals Ltd. Developed by their American parent company, the chemical is 0,2,4,5-trichlorophenyl phosphorothioate. In the liver of man and animals it is rapidly broken down into harmless constituents. Invertebrates cannot cope with it in this way and it is thus an effective killer of fly and insect pests, including those resistant to DDT. Despite its rapid decomposition in the mammalian system, the new insecticide is claimed to be active for from four to eight weeks when sprayed on walls, windows and floors. It has many agricultural, industrial and domestic uses and Dow are marketing it as a wettable powder, an emulsifiable concentrate, in aerosol form, and as granules and dust. It is now being imported but it will soon be made in the new factory which Dow are completing at King's Lynn, Norfolk.

Drugs Versus Cancer

Cancer is a general name that covers more than 300 types of cell disorders, so it is not surprising that the work of finding cures is laborious and expensive. In the U.S., for instance, no fewer than 40,000 chemicals are screened each year for anti-cancer activity, of which fewer than 100 get through to the clinical trials stage. To provide the pharmaceutical industry with a picture of current medical research on cancer we asked two scientists from the Chester Beatty Research Institute, Royal Cancer Hospital, London, to discuss the chemotherapy of cancer and immunological aspects of cancer.

Aspects of the Chemotherapy of Cancer—I

By Walter Davis,* Ph.D.

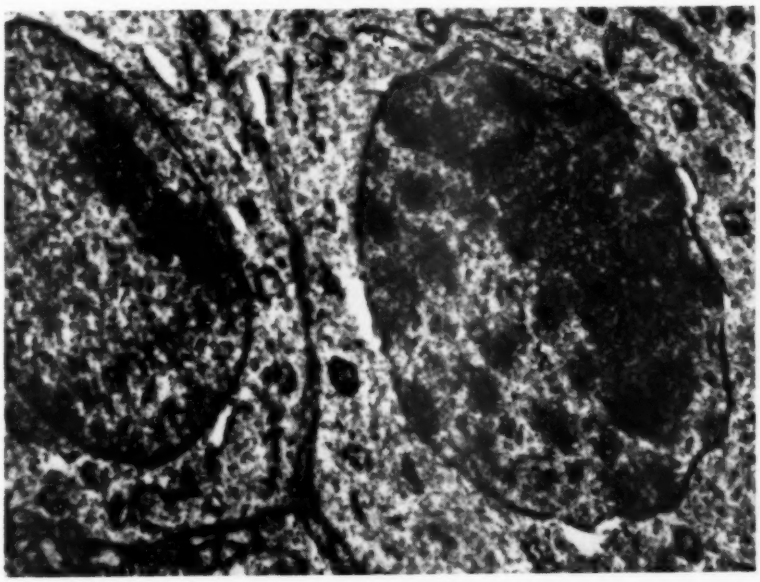
Dr. Davis describes the causes of cancer and considers four groups of compounds: the nitrogen mustards, di-epoxides, the di- and tri-ethyleneimines and dimethanesulphonates. In the second part of his article, to be published next month, he will deal with anti-metabolites, purine antagonists, folic acid antagonists, pyrimidine antagonists, amino acid antagonists, antibiotics and hormones.

LIKE the recipe for jugged hare that begins " First, catch your hare," the problem of curing cancer should begin with first finding the cause, but the causes are manifold and so little understood.

Many chemicals have been implicated as causal agents. These include the polycyclic hydrocarbons in oil and tar which produce a variety of skin cancers, dyestuffs like butter yellow, and the dyestuffs intermediate, β-naphthylamine, that has been identified as a specific causal agent of bladder cancer. Radiations from radium can cause as well as cure cancers. X-rays, too, have been implicated in the induction of leukæmia. Skin cancers have been caused by long exposure to bright strong sunlight. The causal relationship between heavy cigarette smoking and lung cancer is no longer in doubt. The rôle of viruses in human cancers is still the subject of controversy, but a number of benign and malignant growths in animals and birds are virus-induced. Many of the so-called spontaneous human tumours arise in sites subject to normal endocrine activity, and malfunctioning or even malformation of the appropriate sex hormones may be a precursor of cancer in breast, uterus and prostate.

Chemical, physical and biological agents are all capable apparently of producing the malignant transformation.

There is a very wide variation in the characteristics of cancers in different organs. Growth rate and rate of spreading or metastasising—that is, the degree of malignancy—is very variable. There are very great differences between some of the very slow-growing solid tumours that occur in the bladder, for example, and the leukæmias, where the bone marrow—the site of blood formation—the circulating blood and the lymphatic system are all rapidly involved and where the development of the disease from onset to fatal conclusion can, without treatment, be very rapid.



The enemy. Cancer cells from the well-known experimental tumour—the Walker tumour of the rat. × 7,500.

No universal cure

Brief though this introduction may be, it is still sufficient to suggest that no one drug is likely to provide a universal cure or a universal prophylactic. However, the incentive to maintain and expand the programme of chemotherapy research is very strong. Today surgery and radiotherapy are capable of restoring to comfortable, active health very many

* Chester Beatty Research Institute, Institute of Cancer Research, Royal Cancer Hospital, London, S.W.3.

people whose cancer is diagnosed in time, but where diagnosis is delayed, the spread of the disease may make both these methods impracticable. A chemotherapeutic agent that could successfully eliminate metastases would add many thousands more to the list of cancer patients who had been restored to active health. The main target at which research efforts are directed today is the leukæmias for this form of cancer by its very nature should be peculiarly susceptible to drug attack. In this group of diseases, a drug needs only to reach the bloodstream intact to be available to combat the malignant cells throughout the system, whereas the " mopping up " activities of normal blood might prevent drugs from reaching the cancer cells in solid tumours of specific organs.

The position, therefore, that confronts those who are engaged in research into the chemotherapy of cancer is very different from that met with in diseases of microbial or parasitic origin. In those diseases a specific organism foreign to the host organism must be destroyed or its development hampered by the drug. In cancer the targets are malignant cells whose metabolism is only partly distinguishable from the surrounding normal tissue from which they have sprung. Hence specific destruction of tumour cells within their milieu of normal tissue presents a very difficult problem that needs much more information about biochemical differences between normal and malignant cells before a truly rational approach to its solution can be found.

Beginning of chemotherapy

Cancer chemotherapy cannot afford to wait on a truly rational approach and already many drugs have been synthesised that on clinical trials have proved to be of some value, even though the drugs were the outcome of more or less empirical research programmes. The starting point for much of this work was the early observation that certain chemicals were capable of profoundly altering the behaviour of living cells undergoing division, in such a way that prior to dividing, the parent cell seemed normal, but the two daughter cells deriving from the mitotic division were abnormal, so that either they could not divide again—arrested growth—or else they died. The result was in either case chemical growth inhibition, achieved at dose levels that were certainly not toxic to the organism as a whole.

The first chemicals to be extensively studied that were capable of causing this cytotoxic effect were in fact the war gases: " mustard gas "[1] of the 1914-18 war and the later analogue of the second World War—never, fortunately, used—" nitrogen mustard " gas. Studies of their physiological action on experimental animals showed that they exerted a profound depressant effect on the leucocyte count and on the blood-forming tissues in the bone marrow, and from here it was a short step to clinical application of this property to the treatment of the blood cancers, the leukæmias.[2, 3] Nitrogen mustard—HN2—was soon found to be valuable in the treatment of certain leukæmias, in particular Hodgkin's disease, and now 15 years later it is still used as a standard drug. The intervening years have seen a vast development in quantity, if not quality, of drugs that have a familial relationship to HN2.

HN2 is methyl di-2-chloroethylamine hydrochloride (Fig. 1) and

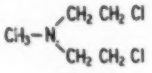


Fig. 1

the many hundreds of its descendants, all known loosely as " nitrogen mustards," carry the di-2-chloroethylamino-functional group, but attached to a wide variety of molecules. The first important modification arose from an attempt to reduce the " war gas " properties of the drug. HN2 is a powerful vesicant and demands the most careful intravenous injection. Its administration is followed by often violent nausea. Nitromin, which is the N-oxide of HN2, was claimed to be less dangerous, but the partial elimination of these undesirable properties was better achieved by switching the aliphatic methyl for an aromatic 2-naphthyl group. This compound (Fig. 2)—known as R.48

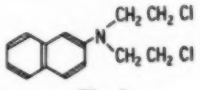


Fig. 2

or Erysan[4]—underwent extensive clinical trials with moderate success. Its most significant advantage was that it could, in contrast to its violent predecessor, be administered orally. The relative success of this drug gave impetus to a programme of synthesising the dichloroethyl derivatives of a large number of readily available aromatic amines. The compounds were substituted anilines and naphthylamines, but while no important new drug came from this work at first, it yielded an important fundamental discovery.

The stability of dichloroethylamines in aqueous solution can be easily determined by the rate at which their hydrolysis produces acidity and chloride ions in the solution (Fig. 3). Examination of a

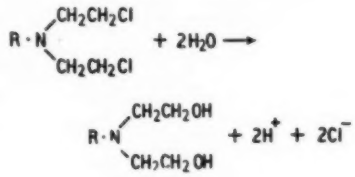


Fig. 3

series of dichloroethyl derivatives of substituted anilines showed that there was a wide variation in their ease of hydrolysis.[5] It was also seen that the hydrolysis followed a unimolecular mechanism, in which the rate-determining step was the separation of the chloride ion and was independent of concentration. In other words, the hydrolysis is a first-order nucleophilic substitution, known as S_N1 mechanism. The first step is the production of the carbonium ion and is common to the other alkylating agents. The nitrogen mustards derived from the weakly basic amines like *p*-nitroaniline or *p*-chloroaniline were very stable compared with the aniline derivative, whilst the compounds derived from *p*-methoxy-aniline and *p*-phenylenediamine which are much stronger bases were very readily hydrolysed. All this could have been predicted from the established rules governing the effects on S_N1 mechanisms of electron donating groups (methoxy and amino) and electron attracting groups (nitro and chloro), but what also appeared was a correlation between ease of hydrolysis and biological activity of the drugs.

The table demonstrates this point (Fig. 4). The compounds with low hydrolysis rates did not inhibit the growth of the experimental rat tumour, the Walker carcinoma, whilst all those with a stability lower than that of the aniline derivative did. Toxicity also seemed to be correlated with the highest rates of hydrolysis.

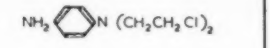
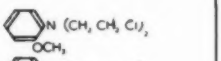
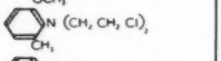
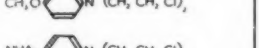
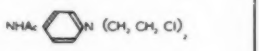
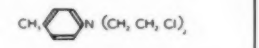
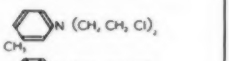
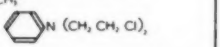
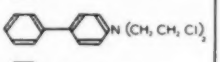
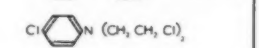
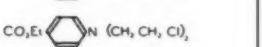
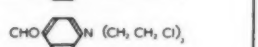
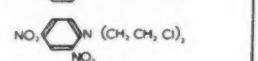
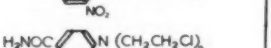
COMPOUND	% HYDROLYSIS IN ½ HR IN 50% ACETONE AT 66°	BIOLOGICAL ACTIVITY
	100	+
	89	+
	83	+
	58	+
	41	+
	38	+
	21	+
	20	+
	12	–
	9	–
	< 1	–
	< 1	–
	< 1	–
	< 1	–

Fig. 4

The correlation holds throughout the whole series of dichloroethylamines, and where there are exceptions they have special biological implications that will be dealt with later in the section devoted to "latent activity" drugs. The importance of this correlation is very great, for the compounds that react easily with water can also react with some of the most important functional groups that exist in living tissue. The dichloroethylamines have been shown to react by alkylation *in vivo* with sulphydryl groups, with the 7-nitrogen in purines and *in vitro*, under physiological conditions with amines, ionised carboxyl and phosphoryl groups, which groups occur widely in proteins and nucleic acids. Here then we are dealing with a group of drugs whose biological activity can be shown to be dependent on their ability to react chemically in the organism—a very explicit demonstration of the classical idea of Ehrlich that a drug's action depends on its ability to block certain "chemo-receptors" in an organism.

Another important discovery was made that has given rise to much speculation about its significance. A number of monochloroethylamines were prepared. Chemically, they were very reactive, but against the experimental tumour they had no effect at all. This need for a molecule with two reactive arms inspired a "cross-linking" hypothesis which considered that biological activity depended on the linking together of adjacent groups on different macromolecular surfaces.[6] As a natural corollary to this, established textile "cross-linking" agents were studied as potential growth inhibitors. From these studies di-epoxides and di- and tri-ethyleneimines, all established "cross-linkers" in textile processing, were shown to possess biological activity similar to the dichloroethylamines. These compounds are alkylating agents too, and in both series a bifunctional molecule is necessary for effective biological activity.

The esters of methanesulphonic acid were known also to be alkylating agents, and when bifunctional compounds in this series were examined, they also were found to possess similar biological activity. Hence there is this wide generalisation, that bifunctional alkylating agents are to some degree all capable of inhibiting experimental rat tumours. But the significance of this generalisation is not yet fully understood. What is known about it will be discussed later.

Out of these four series of alkylating agents — the dichloroethylamines ("nitrogen mustards"), di-epoxides, di- and tri-ethyleneimines and dimethanesulphonates—have come a number of drugs that have possessed some clinical utility in the treatment of leukæmias and, in a very few cases, other forms of cancer.

The "nitrogen mustards"—dichloroethylamines

Apart from HN2, there are perhaps four dichloroethylamines that have so far contributed something to practical therapy. These are known as Chlorambucil, Melphalan, Degranol and Endoxan. In each of these drugs it is the carrying structure that is of special interest. By its very nature the alkylating agent will be indiscriminate in its selection of sites to alkylate. Normal tissue as well as malignant will be attacked and always the bone marrow will be damaged if a high enough dose be given. Therefore there has been a continuous search for a means of making the "nitrogen mustard" more specific in its site of action.

Chlorambucil carries a terminal carboxyl group (Fig. 5) which at

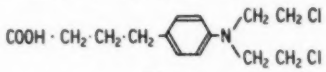


Fig. 5

physiological *p*H would be ionised.[7] This undoubtedly confers a detergent-like property on the molecule, easing its transfer from fatty droplets in which it might be carried round the organism, but within which it would not react, to aqueous cell media in which it would react. The carboxyl group could of course also become associated in salt-linkage, anchoring the molecule to a basic group at a protein surface until the alkylating end of the molecule had reacted and done its job.

Melphalan (Fig. 6) is the *p*-

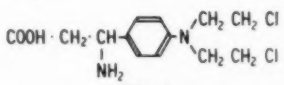


Fig. 6

dichloroethylamine derivative of the naturally-occurring amino acid *L*-phenylalanine.[8] It, of course, would have similar surface-active properties

to Chlorambucil and may in fact owe some of its success to this fact. However, the rationale behind its synthesis was that the attachment of dichloroethylamino - groups to natural occurring metabolites like amino acids might achieve more specificity if the amino acid was involved in its normal metabolism and succeeded in carrying the reactive chloroethyl groups into the metabolic product, where they might then produce their alkylating damage "at the heart of things." The observed fact that the *L*-phenylalanine derivative is much more active than the *D*-form lends credence to this idea, but against this must be set the observations of almost comparable activity in compounds analogous to Melphalan, but derived from amino acids[9] not found in nature and therefore hardly likely to become involved in any metabolic pathway. Incidentally, Sarcolysin, that is widely used in the Soviet Union, is the *DL*-form of this compound.[10]

Degranol (Fig. 7) is the name

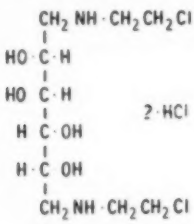


Fig. 7

given by the Hungarians to their chloroethylamino - derivative of mannitol.[11] This is another variant on the natural products theme in which two separate chloroethylamino-groups are attached to a naturally occurring sugar. The same speculation can apply to this compound, that it is, in this case, involved in the carbohydrate metabolism and that it is from this that its therapeutic advantage stems. The four hydroxy groups would also confer much greater water solubility, but the corresponding dulcitol derivative is inactive.

The fourth of these compounds, the cyclic phosphoramide derivative of dichloroethylamine known as Endoxan (Fig. 8), is of special

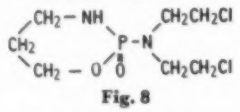


Fig. 8

interest.[12] Earlier, reference was made to the special biological implications of compounds that proved to be exceptions to the general correlation between ease of hydrolysis and biological activity. The hydrolysis rate of Endoxan is very low because the phosphoramidic linkage is powerfully electron-attracting and therefore base weakening. However, if in the organism or, better still, in the tumour there existed a mechanism that could split the phosphoramide bond, di-2-chloroethylamine, itself an active tumour inhibitor, would be released *in situ* (Fig. 9). In fact, it was the belief that abnormally high phosphoramidase activity existed in tumours and might release the active component of Endoxan preferentially in the tumour itself that provided the rationale for its synthesis.

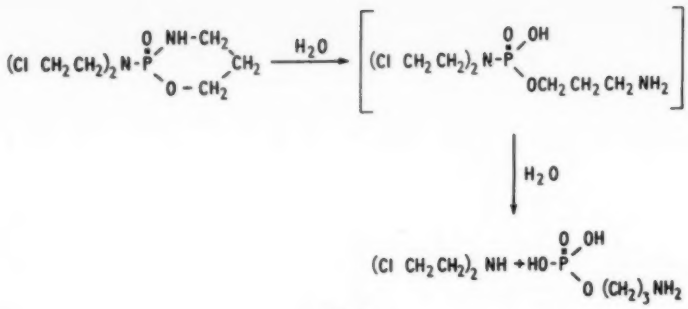


Fig. 9

This concept of synthesising inactive compounds that could be activated *in situ*—so-called "latent activity"—has been realised in many different ways. One of the earliest examples is found in a series of compounds that were derivatives of *p* - di - 2 - chloroethylaminoazobenzene (Fig. 10, I) in which the electron attracting power of the *p*-phenylazo group would make the *in vitro* hydrolysis rate far too low to allow any expectation of growth inhibitory activity by the intact molecule.[13] Reductive fission would however liberate *p*-amino-di-2-chloroethylaniline (Fig. 10, II) and this would almost certainly interfere with growth. There is of course a classical precedent for this in the discovery of Sulphanilamide as the active principle of Prontosil produced *in situ* by enzymic fission (Fig. 11), and experimental studies in the ease of reduction of substituted derivatives of *p*-di-2-chloroethylaminoazobenzene revealed a similar mechanism. It was found that the presence of different substituents in the two azobenzene rings either enhanced or retarded the rate of reductive fission, and if the reduction

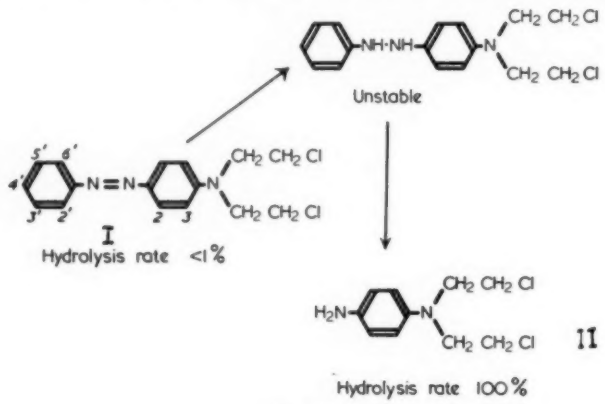


Fig. 10

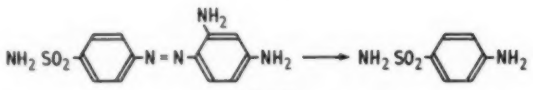


Fig. 11

was achieved by the xanthine/xanthine oxidase system, then there was a clear-cut correlation between ease of reduction and tumour growth inhibition. The most promising member (Fig. 10, 2-CH_3, 2'-COOH) of this series was submitted for limited clinical trial.[14]

Current developments both in this country and the Soviet Union include the syntheses of di- and tri-peptides of Melphalan in the former case and Sarcolysin in the latter, and a variety of other amino-acids. These peptides display a much more favourable chemotherapeutic index than Melphalan or Sarcolysin; that is, they are very much less toxic and therapeutic response can be achieved with a smaller fraction of the toxic dose. Other carrying structures, like 2-5-xylohydroquinone,[15] quinacrine and chloroquine,[16] and the aryl alkyl phosphonates,[17] have not yet been found to offer any chemotherapeutic advantage.

The epoxides

The utility of diepoxides for cross-linking wool fibres to prevent shrinkage has not been paralleled by unequivocal efficacy as tumour growth inhibitors. The most active compound in this series, 1,2 : 3,4-diepoxybutane (Fig. 12) certainly

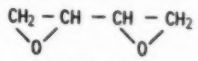


Fig. 12

possesses biological activity capable of inducing mutations in the fruit fly *Drosophila*[18] and micro-organisms like *Neurospora*[19] and *Penicillium chrysogenum*.[20] Its clinical application was reported at the International Cancer Congress in 1958.[21] Recently a group of diamine diepoxides have been found active and submitted for clinical trial.[22]

The ethyleneimines

There are several important drugs in this series. TEM—triethyleneiminotriazine (Fig. 13)—was a

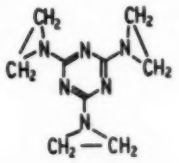


Fig. 13

known textile cross-linking agent before its growth inhibiting properties were substantiated. Thio-TEPA — triethyleneiminothiophosphoramide (Fig. 14)—is the most

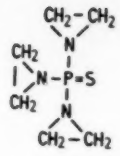


Fig. 14

widely used ethylene-imine derivative. It can be given orally to patients, who generally tolerate it well. More recently, two related compounds known as Bayer E.39 (Fig. 15) and A.139, which are both

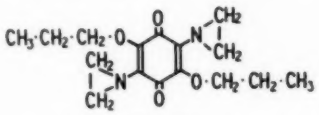


Fig. 15

3,6 - disubstituted 2,5 - diethyleneiminobenzoquinones, have been used in extensive clinical trials in Germany.[23,24] A.139 in which the propyl side chains are replaced by methoxyethyl, has been synthesised in a programme aimed at producing an active alkylating agent of this type that was also easily soluble.

The dimethanesulphonates

The fourth class of alkylating agents, which is also the most recently developed, comprises a series of aliphatic diols esterified with methanesulphonic acid.[25] There is a most interesting relationship between structure and activity in this series which has been extended from the diester of glycol ($n=2$) to that of the straight-chain diol, $n=8$. Activity

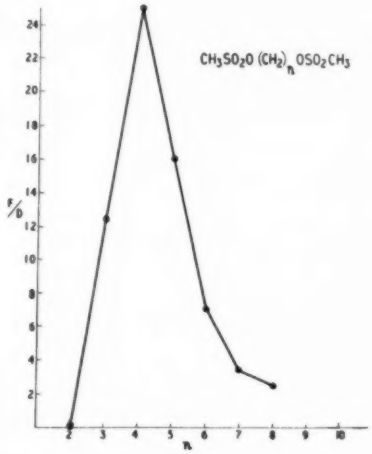


Fig. 16

rises steeply to a maximum for the compound $n=4$ and then falls away equally steeply as the molecule becomes larger (Fig. 16). This most active member of the series is in fact Myleran, which is used clinically in the treatment of chronic myeloid leukæmia. A modification of this drug, analogous to Degranol, called Mannitol Myleran (Fig. 17), has

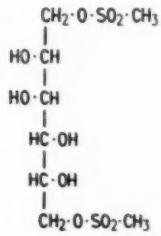


Fig. 17

been found to be an active tumour inhibitor that has very little depressant activity on the blood elements at its effective dose.[26] Some clinical response has also been claimed[27] for the higher member of the Myleran series ($n=9$) known as Nonane.

From these four groups of alkylating agents have come a number of clinically useful drugs, capable of achieving worthwhile remissions with almost complete relief of symptoms for many leukæmic patients. Parallel with the extension of these synthetic programmes, there has been a continuous study of drug mode of action, for it has always been hoped that, were the mechanism known by which a drug exerts its effect, the possibility of designing more effective drugs would be greatly increased. This, then, together with a brief survey of other types of potential anti-cancer drugs, will provide the subject matter for the second part of this article.

REFERENCES

1. E. B. and H. D. Krumbhaar, *J. Med. Res.*, 1919, **40,** 497.
2. A. Gilman and F. S. Phillips, *Science*, 1946, **103,** 409.
3. L. S. Goodman, M. M. Wintrobe, W. Dameshek, M. J. Goodman, A. Gilman and M. T. McLennan, *J. Amer. Med. Assoc.*, 1946, **132,** 126.
4. W. C. J. Ross, *J. Chem. Soc.*, 1949, 183.
5. J. L. Everett and W. C. J. Ross, *J. Chem. Soc.*, 1949, 1972.
6. R. J. Goldacre, A. Loveless and W. C. J. Ross, *Nature*, 1949, **163,** 667.
7. J. L. Everett, J. J. Roberts and W. C. J. Ross, *J. Chem. Soc.*, 1953, 2386.
8. F. Bergel and J. A. Stock, *ibid.*, 1954, 2409.

(*Continued on page* 241)

Viral and Immunological Aspects of Cancer

By D. A. Darcy,* M.A., D.PHIL.

Will it be possible to prevent or cure cancer with vaccines or antisera? The evidence for and against this dramatic possibility is summarised and simplified in this article.

THE virus theory of cancer is not a new thing. It goes back almost to the beginnings of cancer research. Certainly, before viruses were discovered, there were speculations about an infective particle smaller than a bacterium as the cause of cancer. In the heyday of bacteriology, speculations were naturally rife about a bacterial causation of cancer: so many other diseases were yielding to this approach, that it seemed to be the universal answer to the causation of diseases. Up to the present day papers are being published in which a bacterium or mould is reported in association with cancer, with the implication that the micro-organisms are the cause of the cancer.

But a bacteriological origin of cancer is no longer regarded seriously. It is too easy to disprove it, or rather to render it highly improbable, in a multitude of cases. Not so with the viral theory of cancer. As early as 1912, the grand old man of American cancer research, Peyton Rous,[1] had demonstrated that he could transmit cancers in hens by means of cells which had been heat killed and were bacteriologically sterile. The sarcoma in question has been called the Rous sarcoma and is one of the most tried and valued materials in research on the virus aspects of cancer. Later, this demonstration of Rous's was repeated with extracts of the tumour which had been passed through a bacteriological filter without loss of their cancer-producing ability. True, there were plenty of sceptical critics who pointed out that the filters might have had holes or that the heat treatment had not killed all the cells and that even a single cancer cell might give rise to a tumour. But the evidence accumulated and was supported from other fields: if a chemical or a dose of radiation could produce a cancer, why not a virus?

Yet the majority of cancer researchers were against the virus theory and probably still are, if a census were made. And they are certainly in the right, for even today the evidence for a virus causation of certain human cancers, let alone a universal causation of human cancer, is exceedingly tenuous. Why then the interest in it? Mainly because of certain brilliant discoveries made by workers in the virus school during the last few years, which I shall mention below, but also because some of the cancer viruses appear to be essentially a packet of desoxyribosenucleic acid (DNA), which is the material of which our genes appear to be made. The possibility of an interaction between virus DNA and the gene DNA, together with the knowledge that the phage viruses which parasitise bacteria inject their DNA into the bacterial cells and cause a fundamental re-orientation of the cells' activities and behaviour (transduction and other phenomena) has naturally led to intense speculation and experimentation.

* Chester Beatty Research Institute, Institute of Cancer Research, Royal Cancer Hospital, London, S.W.3.

Virus theory in eclipse

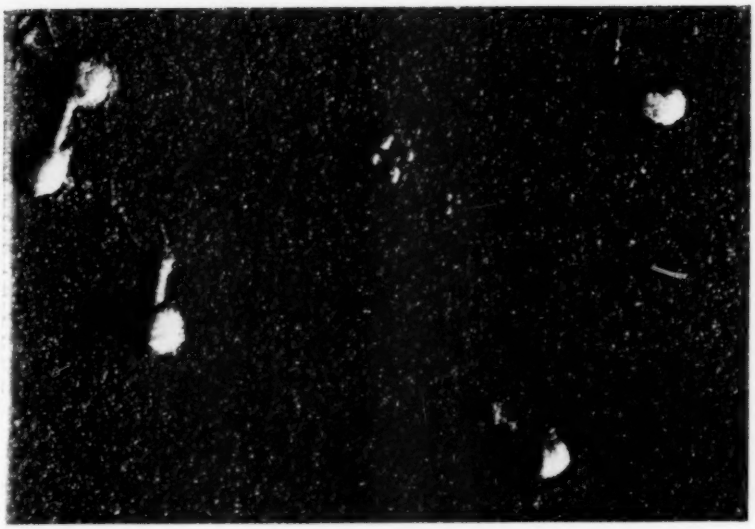
But we are getting ahead of the story. In the twenties and thirties, forties and early fifties, the virus theory was in the doldrums. Most cancer researchers simply dismissed it, giving as their reason that virus causation of cancer had only been demonstrated in one or two instances on lower animals, that it had never been demonstrated in mammals, and that in any case it was just one more carcinogen of which new ones, chemical, physical and biological, were turning up every day. They simply were not impressed and this attitude is probably held by the majority even today, although it has been seriously shaken by the recent discoveries in virus cancer.

During this long period of relative neglect, the virus theory was kept alive in the minds of many cancer researchers by the prominent French investigator Charles Oberling. He might almost be called the apostle of the virus theory from his passionate conviction of its truth and his tireless zeal in propagating ideas about it. He published a fascinating book called "The Riddle of Cancer" which was later translated into English. In it he compared the credibility of the virus theory with other theories in a brilliant and persuasive way, so that the reader required great resistance not to become a convert. His main thesis was that viruses could be the universal cause of cancer, and to account for cases in which no virus had been found associated with the tumour, he postulated the existence of latent viruses in the cell which were raised from dormancy by such agents as X-rays, chemicals, excess hormones, etc. The down-to-earth Anglo-Saxon mind, always distrustful of brilliant speculation and argument not well supported by evidence, felt uneasy about his thesis and preferred theories which seemed closer to the solid ground of fact.

A triumph for the theory

The next major step was made by the American scientist Bittner. He raised two strains of mice, one of which was virtually free from mammary cancer, and the other which had a high incidence of the disease. He was interested in how the disease was transmitted in the high cancer strain. He made the startling discovery that it was transmitted by the mother's milk, so that if new-born mice of the high cancer strain were suckled by a mother of the low cancer strain, they developed little or no mammary cancer, and low cancer strain mice suckled by a mother of the high cancer strain showed a high incidence of the disease in later life. This was a major triumph for the virus theory. The factor passed through bacterial filters and was assumed to be a virus, although this has never been proved. It was found to reside in the tissues of the high cancer strain whether they had tumours or not.

This discovery naturally raised a fearful scare as to whether human mothers of families in which breast cancer had occurred should breast-feed their children. But it soon died down. The mouse situation was recognised to be a very special and artificial one and there was little evidence forthcoming that the same



Virus particles. A phage virus which parasitises the bacterium *E. coli*. × 80,000.

ning could happen in man. In ddition to Bittner's find, another American, Shope, discovered a benign tumour in rabbits, a papilloma, which later progressed to a rank cancer (the V-2 carcinoma). It was found that the papilloma also could be transmitted by a cell-free extract (and hence by implication, a virus). The curious thing was that although the virus or tumour factor existed in the papilloma, it was not found in the cancer which developed from it.

Here were two well-established cases of virus-caused cancers in mammals—a foothold had been gained. Soon leukæmias were discovered in mice which were associated with a virus-like particle, and the great step was made by another American, Ludwig Gross,[2] of discovering that if a cell-free extract of these leukæmias was injected into new-born mice, then a high percentage of these mice developed the leukæmia later in life. This discovery was important because nobody had succeeded in transmitting the leukæmia with a cell-free extract before (Gross had unwittingly made use of the phenomenon of immunological tolerance by using new-born mice), because a new valuable experimental material of great theoretical interest had been provided, and finally because Gross's extracts, in addition to causing leukæmia, also produced other tumours, notably a salivary gland tumour. This work led to a great rash of research and to the important "break-throughs" of the last two or three years.

A break-through

The first and most spectacular of these discoveries was made by S. E. Stewart and her associates[3] in America. She found that if tissue cultures of mouse embryo cells were inoculated with extracts of mouse leukæmias and incubated for two weeks, the supernatant fluid was found to contain an agent which produced a great variety of tumours in mice inoculated at birth. The agent passed through bacteria-proof filters and was later dubbed "polyoma virus." It produces an astounding variety of tumours, not only in mice but also in hamsters. It is highly antigenic and antibodies produced against it in the rabbit completely inhibit its tumour-producing activity in mice.

Two other important discoveries have been made recently. One is by the brilliant American cancerologist H. S. Kaplan, working with his associate Lieberman[4] (1959). They found that filtrates from normal mouse tissues induced no leukæmia in their mice, but when leukæmias had been induced in these mice by means of X-rays, filtrates of these tumours gave rise to leukæmia on inoculation into other mice of the same strain. The inference is strong that the virus or active principle was latent in the cells of the normal mouse but "activated" by the X-radiation. Thus one of the main predictions (one might almost say, prophecies) of Charles Oberling appears to have received its first confirmation.

The other discovery is only a few months old. It appears that a team of American investigators have been able to induce leukæmia in mice by means of DNA alone which they extracted from polyoma virus, and that whole virus is then generated by the infected host cells (di Mayorca *et al.*, 1959).[3]

What is one to make of this furore over virus research in cancer, and what is its importance for the human disease?

At present it may be said that its interest is mainly theoretical. It promises to throw powerful light on the mechanism of carcinogenesis, it may provide a meeting point for the great rival theories of cancer causation, the virus theory and the theory of somatic mutation (which states, roughly, that the carcinogenic agent causes a genetic mutation in a body cell and that the mutation permits unrestrained cell division). The extreme exponents of the virus school hold that all cancer is caused ultimately by viruses and they naturally seek to eliminate rival theories. The great majority of cancer researchers prefer to suspend judgment until more evidence is forthcoming. It is a hard fact that there is not a single type of human cancer which is known to be caused by a virus. Some have tried to demonstrate it for certain types of leukæmia, including Gross himself, but the argument still remains largely in the realm of speculation. It is also a consoling fact that, virus causation or not, cancer is not a communicable disease.

A vaccine?

Supposing, however, that in a few years' time the virus causation of some or all human cancers should be proved, what could we do about it? If it did happen it would be a blessing, because at least we can hope to deal with a virus, whereas the outlook for dealing with a somatic mutation can only be poor (as Sir Macfarlane Burnet, a powerful exponent of this theory, has admitted (1957)[5]). With a virus we can at least prepare a vaccine (along the lines, perhaps, of the Salk polio vaccine) in order to immunise people in advance, or possibly therapeutically, when they have the disease. The trouble is that there may be a multitude of viruses, even one for each individual tumour, so that pre-

vaccination might be hopeless. However, this may be unduly pessimistic and, in any case, non-specific antiviral agents might be discovered. The other possibility would be the production of antisera to be used either prophylactically or therapeutically.

Immunology and cancer

The last topic leads naturally to the subject of immunity and cancer. Ever since the discovery of immunity against foreign organisms and the remarkable substances called antibodies, investigators have been fascinated by the speculation that this truly wonderful mechanism might provide the cure for cancer. Thousands have tried, so far none has succeeded. Perhaps the reasoning is too naïve, too full of wishful thinking. The underlying assumption of all these attempts, whether realised or not, is that there exists a specific cancer antigen, that is to say, a substance of high molecular weight (*e.g.*, protein or polysaccharide) either in the cancer cell or on its surface, which is absent from the normal cells of the body. It is on this assumption, which is no more than a hope, that all such work is based. Why should the cancer cell possess a new and foreign substance? There is no good theoretical reason. Furthermore, some of the best experimental work has shown that so far from possessing a special substance (antigen), the cancer cell is deficient in one or more antigens (proteins) possessed by the normal cell (Miller and Miller, 1952;[6] Weiler, 1956;[7] Hughes, 1958[8]). This is what would be expected from our knowledge of the cancer cell.

If the cancer cell possesses nothing more than a deficiency of an antigen which the normal cell possesses, then the hope of a cancer cure by immunisation is not great. It is difficult to see how one could make practical use of the *absence* of a handle, except possibly by using the " handles " of all the normal cells to attach some protective " shield " to them while a toxic agent is administered to the entire organ or body. This would seem rather impractical and there is the danger that the antibodies would seriously damage the normal cells. Chemotherapy, on the other hand, might conceivably be able to make use of this " gap " in the cancer cell.

Yet in spite of the lack of theoretical support for their idea and the failures of the past, a surprisingly large number of cancer investigators continue to search for the cancer antigen or, what amounts to the same thing, to cure cancer by immunological means. The latter type of experiment is preferable because it is more convincing and kills two birds with the one stone—you demonstrate your antigen and show that it is effective at the same time.

The literature in this field is vast and goes back to the early part of the century. Great claims have been made for this or that vaccine or serum, none of which has been substantiated. Much of this work was vitiated by ignorance of the homograft reaction. It would be best, therefore, to mention only some representative modern work in the field. Claims of having discovered specific cancer antigens appear with great regularity backed by skilled experimental work and a variety of sensitive modern techniques. This is a field in which Russian cancer scientists have laid great emphasis, headed by their leading immunologist, L. A. Zilber.

Russian work . . .

A considerable number of Russian workers unanimously report the existence of an antigen in tumour extracts which is absent from the corresponding normal tissue (Vygodchikov, 1959).[9] In the main they used the technique of sensitising a guinea pig with the cancer preparation, then, after an interval of some weeks, desensitising it with a normal tissue preparation, followed immediately by an injection of the cancer preparation. If the guinea pig goes into anaphylactic shock, it shows that there was some antigen in the cancer extract which was absent from the normal. Other immunological methods were sometimes employed and confirmed the result. But the proof of the pudding is in the eating, and so far no reports have issued from Russia or anywhere else of cancer cures by immunological means.

. . . and American

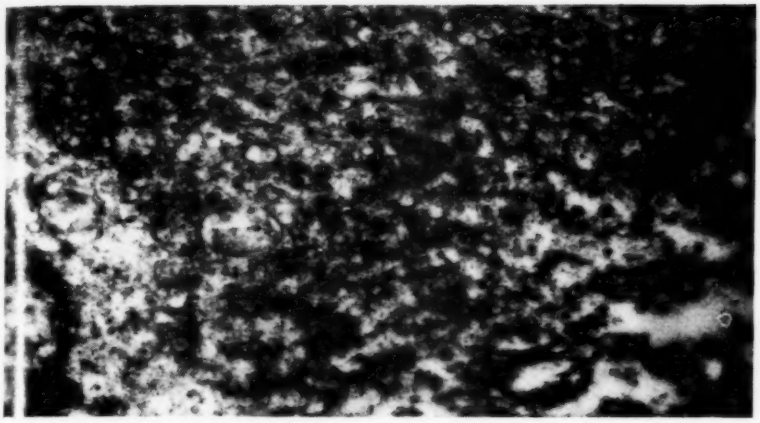
Somewhat similar demonstrations have been made in America by Makari (1955),[10] who removes the uterus of the sensitised guinea pig and uses it in a Schultz-Dale bath to indicate the presence of a cancer antigen. He finds his cancer antigen in the serum as well as the tumour of the patient, and uses his method as a diagnostic test for cancer. He admits that the method is complicated and tricky.

One of the best pieces of work on this subject is that of Prehn and Main (1957),[11] who found a specific antigen in methylcholanthrene-induced sarcomas in inbred mice by the reliable technique of iso-transplantation. The tumour immunised its strain of origin, whereas normal tissue did not. But not all the methylcholanthrene - induced tumours possessed this antigen; spontaneous tumours of similar appearance possessed no antigen; and one of the chemically-induced tumours shed its antigen in the fifth or sixth transplant generation. The authors concluded that the specific antigen had no intrinsic part in the carcinogenic process but was rather an accidental concomitant change.

Vaccine trials

Turning now to the type of investigation which is concerned not so much to demonstrate a cancer antigen as in the practical aim of curing cancer. These experiments, if they come off, can actually be more effective than the pure search for the cancer antigen, for they demonstrate the antigen and its effectiveness at one blow. A recent example is the work of Graham and Graham (1959).[12] These authors had previously shown that there was an antibody in the blood of certain cancer patients which reacted with the tumour cells. This suggested the idea of trying to increase the titre of such antibodies by injecting the patients with vaccines made from their own tumours. Various types of vaccine were tried. The results suggested that the vaccines may have had a beneficial effect in some patients; the best results appeared to come from using whole cancer cells or whole cell homogenates in the vaccine. But the work is preliminary and no statistical control was possible. Furthermore they were compelled to work only with advanced cancer cases.

This work was recently confirmed by Finney, Wilson and Byers (1959),[13] who found that tumour nodules in the patient temporarily regressed after the vaccination. Even more interesting, they found that serum removed from the patient at the height of immunisation and reinjected later when the patient's antibodies had fallen (and the tumour had re-grown) caused a second temporary regression of the patient's tumour nodules. But against this is



Unknown virus (dark spheres with clear halo) in the cytoplasm of a cancer cell—the Ehrlich ascites tumour. × 24,000.

the fact that X-radiation without any vaccination had the same effect, *i.e.* it was followed by the temporary regression of distant tumour nodules which had not been irradiated. The authors, however, ascribe this also to an immune effect: the irradiation caused a release of tumour antigen which immunised the patient, they say; and certainly there was a measurable increase in antibody titre following irradiation.

Finally there is the undeniable fact that a small percentage of human cancers (it is estimated as 1 in 100,000) are spontaneously cured. When these spontaneous cures are examined, there is a group which suggests that they might be of immune origin, *e.g.* a recovery following an acute infection or fever. But no one has succeeded in repeating such a cure clinically, nor has the experimental work with animals borne much fruit. It is wise to remember in this last connection the advice of Graham and Graham, that one should not be put off by the negative results obtained with animal tumours, for these grow so fast that they may not be comparable with human tumours, particularly in the matter of immunisation.

* * *

To summarise, research on the viral origin of cancer has yielded some very surprising and interesting results in the last two or three years. More and more mammalian tumours are being produced by means of viruses, and much light is being shed on the mechanism of carcinogenesis. Nevertheless, there is as yet not a single established case of virus-caused cancer in man. Should a virus etiology be proved for certain human cancers, then a vaccine prophylaxis may prove feasible.

With regard to the immunological aspects of cancer, no one has succeeded so far in curing human tumours (or indeed spontaneous animal tumours) by means of either antisera or vaccines, although results suggestive of partial cures have been reported and these show promise. The mere demonstration of a cancer antigen is not a very fruitful activity unless its nature and the theoretical importance can also be demonstrated, or else its therapeutic effectiveness. Otherwise the demonstration will be suspect either on the grounds that the normal controls were inadequate (which is true in most cases) or that the antigen may be merely an unimportant by-product of cancer cell metabolism, such as the abnormal protein produced by the cells of multiple myeloma in place of normal gamma globulin, or it may even reflect a micro-organism parasitic on the cancer cell.

REFERENCES

1. P. Rous and J. B. Murphy, *J. exp. Med.*, 1912, **15,** 270.
2. L. Gross, *Cancer*, 1953, **6,** 948.
3. G. A. di Mayorca, B. E. Eddy, S. E. Stewart, W. S. Hunty, C. Friend and A. Bendich, *Proc. Natl. Acad. Sci.*, 1959, **45,** 1805.
4. M. Lieberman and H. S. Kaplan, *Science*, 1959, **130,** 387.
5. M. Burnet, *Brit. Med. J.*, 1957, **i,** 779 and 841.
6. J. A. Miller and E. C. Miller, *Cancer Res.*, 1953, **1,** 339.
7. E. Weiler, *Brit. J. Cancer*, 1956, **10,** 553.
8. P. E. Hughes, *Cancer Res.*, 1958, **18,** 426.
9. G. V. Vygodchikov (Editor). "Pathogenesis and immunology of tumours." London: Pergamon Press. 1959.
10. J. G. Makari and M. G. Huck, *Brit. Med. J.*, 1955, **ii,** 1291.
11. R. T. Prehn and J. Main, *J. Nat. Cancer Inst.*, 1957, **18,** 769.
12. J. B. Graham and R. Graham, *Surg. Gynec. Obstr.*, 1959, **109,** 131.
13. J. W. Finney, R. H. Wilson and E. H. Byers, *J. Lab. Clin. M.*, 1959, **54,** 814.

CHEMOTHERAPY OF CANCER

(*Continued from page* 237)

9. W. Davis, J. J. Roberts and W. C. J. Ross, *ibid.*, 1955, 890.
10. L. F. Larionov, E. N. Shkodinskaya, V. I. Troosheikina, A. S. Khoklov, O. S. Vasim and M. A. Novikova, *Lancet*, 1955, **269,** ii, 169.
11. L. Vargha, L. Toldy, O. Feher and S. Lendval, *J. Chem. Soc.*, 1957, 805.
12. H. Arnold, F. Bourseaux and N. Brock, *Naturwiss.*, 1958, **45,** 64.
13. W. C. J. Ross and G. P. Warwick, *J. Chem. Soc.*, 1956, 1364.
14. L. G. Israels and S. Ritzmann, *Abstracts VIIth Internat. Cancer Congress, London*, 1958, 186.
15. C. Weatherbee, R. Temple and W. J. Burke, *J. Org. Chem.*, 1956, **21,** 1138.
16. R. Jones Jnr., C. C. Price and A. K. Sen, *ibid.*, 1957, **22,** 783.
17. F. Kagan, R. D. Birkenmeyer and R. E. Strube, *J. Amer. Chem. Soc.*, 1959, **81,** 3026.
18. M. J. Bird, *J. Genetics.*, 1952, **50,** 480.
19. G. Kolmark and M. Westergaard, *Hereditas*, 1953, **39,** 209.
20. J. A. Hendry, R. F. Homer and F. L. Rose, *Brit. J. Pharm.*, 1951, **6,** 235.
21. J. Bichel, *Abstracts VIIth Internat. Cancer Congress, London*, 1958, 32.
22. K. Gerzon, J. E. Cochran Jnr., L. A. White, R. Monahan, E. V. Krumkalns, R. E. Scroggs and J. Mills, *J. Med. and Pharm. Chem.*, 1959, **1,** 223.
23. W. Gauss and S. Petersen, *Angew. Chemie*, 1957, **69,** 252.
24. G. Domagk, *Ann. N.Y. Acad. Sci.*, 1958, **68,** 1197.
25. A. Haddow and G. M. Timmis, *Lancet*, 1953, **1,** 207.
26. A. Haddow, G. M. Timmis and S. S. Brown, *Nature*, 1958, **182,** 1164.
27. E. Miller, *Ann. N.Y. Acad. Sci.*, 1958, **8,** 1205.

Antiseptics and disinfectants. Monsanto Chemicals Ltd. have issued a technical bulletin on *Cresantol 16*, a blend of chloroxylenols for preparing antiseptic and disinfectant fluids for personal and general use. Three formulæ are given for preparing disinfectant fluids, namely:

	% *w/v*		
	1	*2*	*3*
Cresantol 16	2	2	2
Pine oil	—	4	—
Terpineol	4	—	4
Industrial methylated spirit	8	10	8
Isopropyl alcohol ..	–	–	8
50% castor oil soap ..	8	12	8
Water	to 100	to 100	to 100
R.W. Coefficient ..	4·0	4·2	4·5

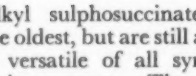
The Sulphosuccinate Wetting Agents

By J. S. Stanley,* B.SC., PH.D.

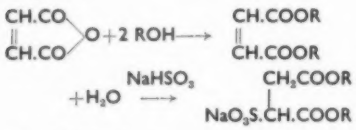
The dialkyl sulphosuccinates are among the most potent wetting agents known and, being available in a pure form which is oil-soluble, have also been widely used as emulsifying agents. The properties of the various members of the series and their use in the formulation of pesticides and pharmaceuticals are discussed.

THE dialkyl sulphosuccinates are some of the oldest, but are still among the most versatile of all synthetic surface-active agents. They were first produced during the inter-war period by the American Cyanamid and Chemical Corporation under the trade name *Aerosol*, of which Aerosol OT, dioctyl sodium sulphosuccinate is probably the best known.[1] It should be noted that not all the surface-active agents marketed under the trade name Aerosol are dialkyl sodium sulphosuccinates; Aerosol SE, for example, is a cationic material.

The dialkyl sodium sulphosuccinates have the general formula



where R is a straight or branched chain alkyl group. They are made by esterifying maleic anhydride and reacting the resulting ester with sodium bisulphite.



In Table 1 the compounds commercially available are listed, together with the trade names used by the various manufacturers. For the sake of brevity the designation given by American Cyanamid will be followed in this article.

All the materials listed are available as 98/100% active materials which are waxy solids, and as solutions in aqueous alcohol, usually containing 50% of active material. Aqueous gels of the same strength are also available for those applications where even traces of the solvent are undesirable.

Aerosol OT in its pure form is a soft waxy solid melting at 153°–157°C. and is usually sold as pellets approximately ¼ in. diameter. These pellets tend to cake when stored in bulk. A free-flowing powder suitable for incorporating into powdered detergents, wettable powders, etc., can be obtained by mixing the solution with at least 5% by weight of sodium benzoate and spray drying.[2] Aerosol OT-B is such a product; it contains 15% of sodium benzoate and has an ultimate particle size of 15–150 microns. In general the sodium benzoate may be considered as an inert diluent, but, because of its presence, the wetting agent is then not soluble in all organic solvents.

Table 1.—Commercially available Dialkyl Sulphosuccinates

R.	*American Cyanamid*	*Allied Colloids*	*Hardman and Holden*	*Norman Evans and Rais*
Isobutyl	.. Aerosol IB	—	Manoxol IB	—
Amyl	.. Aerosol AY	—	Manoxal AY	—
1 : 4-dimethylbutyl	.. Aerosol MA	—	—	—
2-ethylhexyl ..	.. Aerosol OT	Alcopol O	Manoxol OT	Anionaid T
n-octyl	.. Aerosol OT-N	—	—	—
3,5 5-trimethyl hexyl	..	Alcopol ON	Manoxol N	Anionaid DN

Wetting power

Under some circumstances the sulphosuccinic esters are the most powerful wetting agents known, and since they are soluble in organic solvents they are also useful as emulsifying agents, either alone or in combination with non-ionic emulsifying agents, upon which they may have a synergistic effect.

The highly branched chain structure of the sulphosuccinic esters reduces their tendency to form ionic micelles in solution. A higher concentration of free ions can therefore be obtained and, since it is only these which are surface active, a high surface activity. The highly branched chain structure also decreases the crystallinity and therefore increases the solubility of the product. Aerosol OT dissolves in cold water, forming clear solutions up to 1·5% in strength, whereas sodium dodecane sulphonate, a straight chain surfactant containing a lower number of carbon atoms in the hydrocarbon chain, is not appreciably soluble below 40°C.

The superior wetting ability of the sulphosuccinate wetting agents is not due to any specifically great surface activity of the paraffin chain ion, but to the reduced tendency for micelle formation and low crystallinity caused by the highly branched chain structure.

Below approximately 1·5% solutions of Aerosol OT in distilled water are clear. Solutions in hard water are cloudy but the wetting properties are not impaired. Aerosol OT is salted out by moderate concentrations of electrolytes and under these conditions lower members of the series such as Aerosol MA or AY should be used. The presence of salts increases the wetting power of the lower members of the series. The addition of 15% sodium sulphate to a 0·05% solution of Aerosol AY, for instance, reduces the surface tension from 57 to 28 dynes/cm.[3]

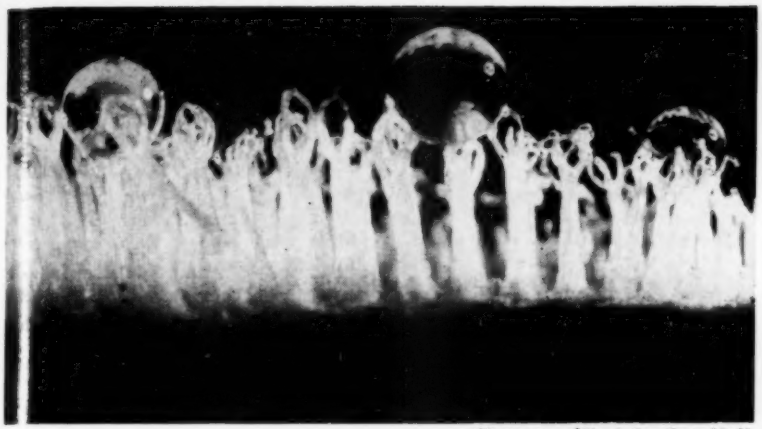
As can be seen from the structural formulæ, the sulphosuccinic esters contain two ester linkages. They are therefore not stable in alkaline solutions above *p*H 10. If the wetting agent is to be incorporated in a formulation where a shelf life of several months is required, the writer's experience is that the *p*H should not be above 8. The sulphosuccinic esters can be used in acid solutions above *p*H 2.

Agricultural and horticultural sprays

The extremely powerful wetting action of the dialkyl Na sulphosuccinates combined with their solubility in almost all organic solvents makes these compounds particularly suitable for incorporation in agricultural spray formulations.

In spite of their ability to lower the interfacial tension at the oil/water interface the dialkyl sodium sulphosuccinates are not themselves particularly good emulsifying agents,

* J. A. Radley, Industrial Research and Development Laboratories.



(*By courtesy of Fison's Pest Control Ltd.*)

Fig. 1. Water droplets on leaf of salvinia—an extreme example of water repellency.

but when used in conjunction with nonionic emulsifying agents they have a marked synergistic effect. The amounts required are from 5–10% of the total amount of emulsifying agent used. Emulsions containing mixtures of nonionic emulsifying agents with Aerosol OT are more stable in hard water. It would therefore seem possible that the use of calcium rather than the sodium salt of Aerosol OT would give better emulsions in soft water.

The great wetting power of the sulphosuccinate wetting agents is imparted to the diluted emulsion.

The desirability of adding wetting agents to agricultural spray solutions was discussed by the writer in a previous series of articles in this journal.[4] Addition of a wetting agent may improve the effectiveness of the spray by increasing the quantity retained on the plant and also by improving the evenness of distribution of the deposit.

The leaves of the various species of plants differ greatly in the ease with which they are wetted by water. The contact angle of water on some leaves, such as those of the potato, is quite low, so that most of the spray solution which strikes the surface is retained there. Other leaves such as those of the pea or banana are powerfully water repellent. An extreme case of this is the water weed, *salvinia*, which is covered with fine branched hairs (Fig. 1). The droplets of spray on striking these leaves bounce off unless a wetting agent is present, so that as little as 5% of the spray reaching the target may be retained by it.[5]

In some instances of weed control this may be of advantage in that the selectivity of the spray may depend in large measure upon the differences in spray retention.

Wetting agents are essential when unwettable crops such as peas or bananas are sprayed with insecticides or fungicides. The wetting agent ensures high retention and uniform distribution of the insecticide over the leaf surface. Penetration of the leaf cuticle or the insect cuticle may also be aided by the presence of the wetting agent.[6]

In high volume spraying when the leaves are sprayed to beyond "run-off" the wetting agent may reduce the quantity of spray retained on the leaf surface. A specific effect of the dialkyl sodium sulphosuccinates has been noted and it has been found that Aerosol OT causes a greater reduction in the amount of the run-off deposit than non-ionic wetting agents.[7]

A similar effect has been noted in these laboratories, where the quantity of wetting agent solution remaining on glass plates has been determined.[8] The glass plates were completely wetted by the solutions, but the amount retained was lower when Aerosol OT was used.

The reason for this is that deposits of solutions of nonionic wetting agents dry uniformly on the surface, but that considerable channelling occurs as solutions of Aerosol OT evaporate. The solution drains more rapidly down these channels. The effect is illustrated in Figs. 2 and 3, which are autoradiographs of the dried deposits on glass slides. Radioactive sodium phosphate was added to the solutions as an indicator.

Wetting agents may cause scorching on plant leaves, and tests carried

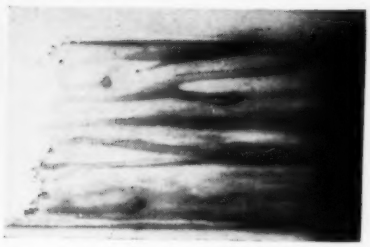


Fig. 2. Autoradiograph of dried deposit of 0·25% Aerosol OT on a vertical glass slide.

Fig. 3. Autoradiograph of dried deposit of 0·25% alkyl phenol polyglycol ether on a vertical glass slide.

out at Long Ashton Research Station[9] have shown that this is influenced by the type of wetting agent and its concentration. Cationic wetting agents are particularly phytotoxic, but nonionic wetting agents appear to be safe at even high concentrations. The anionic wetting agents, including Aerosol OT, can cause scorch at high concentrations, but are safe at the low concentrations at which they are likely to be used.

Uses in pharmaceuticals

Toxicological studies of Aerosol OT show that it exhibits a low order of acute toxicity.[10] The acute oral LD_{50} to mice is approximately 1 gm./kg. Various species of laboratory animals have been fed doses as high as 0·87 gm./kg. daily for as long as six months without evidence of toxic effect beyond occasional diarrhœa. Human patch tests with 1% aqueous solutions of Aerosol OT disclosed no evidence of irritation and 0·25% aqueous solutions when applied to wounds resulted in no adverse effects.

In common with all powerful wetting and emulsifying agents, the product will remove natural oils from the surface of the skin, leading to dryness and fissuring.

The lower numbers of the series, Aerosols MA, AY and IB, are some-

what less toxic than Aerosol OT.

Aerosol OT has some bactericidal properties itself. Gale and Taylor[1] treated *Streptococcus fæcalis* with Aerosol OT solution and found that the cell wall was so affected that it allowed the amino acids to leak out.[11] The toxicity to a number of test organisms noted by Macdonald and Tatum [12] is probably due to its lytic action. The toxicity of Aerosol OT to bacteria is not, however, as great as that of the quaternary ammonium compounds.

Aerosol OT has been found to increase the activity of many germicides by acting as a synergist.[13] Thus the dilution of phenol required to kill *Staphylococcus aureus* is increased from 1 : 75 to 1 : 180 by Aerosol OT at a dilution of 1 : 5000. The dilution hexyl resorcinol is similarly increased from 1 : 5000 to 1 : 20,000.

In the manufacture of antibiotics, Aerosol OT has been used to precipitate neomycin, with which it forms an insoluble complex, from fermentation liquors[14] and also to assist in the extraction of penicillin from the broth into organic solvents.[15]

Aerosols OT and MA have been recommended as additives to tablets to increase the disintegration rate,[16] and as an active ingredient in contraceptive creams.

Aerosol OT has also been recommended in ointment bases for dermatological formulations, but a stabiliser is usually required. In some formulations the high wetting power of the ester is utilised to assist skin penetration. The preparation, as a consequence, exerts a strong degreasing and drying action on the skin.[17]

Analysis

In common with most anionic surfactants, Aerosol OT can be estimated by titration with a cationic surfactant using methylene blue as indicator.[18] The sulphosuccinic esters can also be determined by hydrolysis with alkali and estimating the amount of alkali consumed.[19] Traces can be estimated colorimetrically using basic fuchsin.[20] This method is particularly useful for estimating traces left in textile fabrics.

Detection of changes in the physical properties of the solution is a convenient method for studying stability, *e.g.* in agricultural pesticide formulations. This can conveniently be done by comparing the surface tensions of the solutions, suitably diluted. The drop volume method of Harkins and Brown, using an Agla micrometer syringe,[21] is a convenient method for determining surface tension accurately. By this method it is possible to detect when as little as 5% of the wetting agent has decomposed.

REFERENCES

1. American Cyanamid & Chemical Corp. and Jaeger. U.S.P. 2,028,091.
2. American Cyanamid & Chemical Corp. U.S.P. 2,441,341.
3. American Cyanamid & Chemical Corp. "Aerosol" Surface Active Agents. (Technical Brochure).
4. Stanley, MANUFACTURING CHEMIST, 1958, **29,** 334, 385.
5. Brunskill, *Proc.* 3rd Brit. Weed Control Conf., 1956, Vol. 2, 585.
6. Furmidge, *J. Sci. Food & Agric.*, 1959, **10,** 274.
7. Somers, *ibid.*, 1957, **8,** 520.
8. Stanley and Radley. Unpublished.
9. Furmidge, *J. Sci. Food & Agric.*, 1959 **10,** 519.
10. Benaglia, Robinson, Utley and Cleverdon, *J. Industrial Hygiene and Toxicology*, 1943, **25,** 175.
11. Gale and Taylor, *J. Gen. Microbiol.*, 1947, **1,** 77.
12. Macdonald and Tatum, *J. Immunol.*, 1948, **59,** 301.
13. Gershenfeld and Perstein, *Am. J. Pharm.*, 1941, **113,** 237.
14. Allen, B.P. 785,982.
15. Finn, U.S.P. 2,563,779.
16. Cooper and Brecht, *J. Am. Pharm. Assoc.*, 1951, **46,** 520.
17. Martin, MANUFACTURING CHEMIST, 1954, 242, 291.
18. Epton, *Trans. Faraday Soc.*, 1948, **44,** 226.
19. Wallin, *Anal. Chem.*, 1950, **22,** 616.
20. American Cyanamid and Chemical Corp. "Aerosol" Surface Active Agents (Technical Brochure).
21. Adam, "Physics and Chemistry of Surfaces," 1941, 3rd Ed. Oxford University Press.

ACCURACY ABOVE ALL

"There are two reasons why the author of a paper should take all possible trouble to reduce to a minimum the need for editorial amendment of his manuscript. First, he will thereby establish some degree of confidence towards himself not only from the editor but also from any assistant editors or referees to whom his draft is submitted; a reputation for scrupulousness in the preparation of manuscripts for the press cannot harm and may enhance the author's reputation for general reliability, even in his own field of science. Misdemeanours in these matters are, by that same token seldom forgotten."

"The second reason is simply good manners. Many editors and referees acting for scientific and technological journals, especially those that primarily cover the basic sciences and are published by learned societies, work in a purely honorary capacity, being already fully employed in research, teaching or administrative jobs undertaking their additional tasks as labours of love. Anyone who, through carelessness or laziness, increases their work unnecessarily—and indeed this is also true, *mutatis mutandis*, for the paid editor—is simply guilty of gross discourtesy to a scientific colleague. The matter is one neither of science nor of English, but just of professional courtesy."—A. L. Bacharach, reviewing "The Technical Writer" in *Nature*.

Eltesol hydrotropes. A hydrotrope is a compound which, when dissolved in water, will assimilate molecules of other compounds normally insoluble in water. The resultant solutions, below a limiting concentration, are homogeneous, clear, and mobile. The substituted aromatic sulphonates possess hydrotropic properties and are used in the detergent field as coupling agents and solubilisers. They will also reduce the consistency of slurries and have many applications by virtue of this property.

The Eltesol hydrotropes are a series of aromatic sulphonates manufactured by Marchon Products Ltd. who have recently published a booklet about them.

Mr. Therm at work. Facts and figures on the uses of gas in various trades and industries are given in the latest Gas Council publication, "What a Therm of Gas will do in Industry." This booklet explains that a therm is the heat needed to bring to the boil 60 to 64 gal. of cold water —and makes the point that the manufacturer knows that he can rely on gas to give him the exact amount of heat he needs for each industrial process. The examples given of the use of an industrial therm vary from drying the backing of wax duplicating stencils to frying fish and chips; from metal melting to producing the glassware for 70 electric lamps.

Mechanical handling. Four publications from J. Collis and Sons Ltd. deal respectively with their conveyors, including the RolaVeyor, the Collis Truck, the Collis Electric and Manual Hydraulic Stacker, and the pallet type truck.

Flow Measurement and Control Equipment

By A. Linford, B.Sc., A.M.I.C.E., A.M.I.W.E.

In this review the author deals with the measurement and control of fluids at low rates of flow, the conditions most often met in chemical manufacturing. He discusses the following types of flow meters: differential pressure, variable area, electromagnetic and mechanical. He then considers mass flow measurement and concludes with a brief survey of automatic flow control.

Among the many measurements of the values of physical variables which are so important in modern manufacturing processes, that of accurately metering the flow of fluids presents great practical difficulties.

Problems are caused by the viscosity of the fluid, its corrosive properties, the presence of suspended matter and change in density associated with random variations in its composition and/or changes in temperature and, in the case of gases, changes in pressure as well. These difficulties are accentuated at low flow rates which are frequently the conditions of particular interest to the chemical industry, *e.g.* in the manufacture of small batches of chemicals.

Differential pressure type flow meters

Unquestionably, the flow meter of the widest application is the differential pressure type. It consists of a differential pressure producing device, such as an orifice plate or a Venturi tube, which is inserted into the pipeline. The differential pressure produced, which is directly proportional to the square of the rate of flow, is conveyed, through small bore tubes, to a measuring instrument which registers the differential pressure in terms of rate of flow. The simplest form of measuring unit is the glass tube manometer.

Depending on the rate of flow, density of the fluid and size of pipe, a critical viscosity value is obtained, above which inaccurate metering results. Bearing in mind that metering under industrial conditions is being considered, under suitable conditions flows through pipes as small as about 1 in. bore can be accurately metered.* In this connection it may be noted that special designs of orifice plates are available which are less susceptible to the viscosity effect.

* British Standard Code, B.S. 1042: 1943, "Flow Measurement," recommends a minimum bore of 2 in.

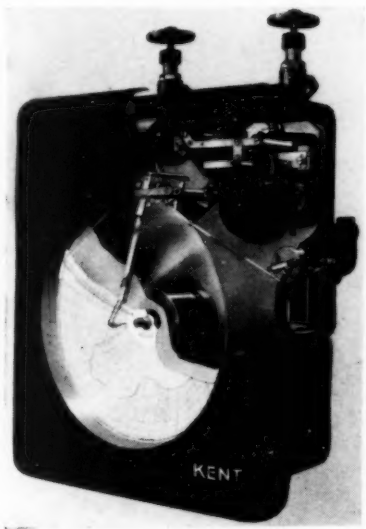


Fig. 1. Cut away view of mercury U tube type flow recorder and integrator. (George Kent)

Differential pressure meters can be calibrated to register correctly in weight or volume units at a particular fluid density. Because the differential pressure produced is proportional to the square of the flow rate, the percentage error in registration caused by a change in density is approximately half the percentage change in density, *i.e.* a 5% change in density from the mean value will only cause a 2½% meter error.

By using a bellows - operated measuring unit, a mercury filled metal "U" tube (Fig. 1) or, in the case of low-pressure gases, an oil-sealed differential pressure measuring unit, the rate of flow can be indicated on a dial by a pointer, recorded and integrated as well. Instruments of this description can be fitted with electric contacts, can be used as electric or pneumatic transmitters, or fitted with automatic flow controlling units.

For dealing with corrosive fluids, the differential pressure producing device fitted into the pipeline can be made of a suitable resistant material. However, it is not economical to manufacture the differential pressure measuring unit and associated pipework of special materials, *e.g.* of ebonite or an appropriate grade of stainless steel. Also, not infrequently, the nature of the fluid is such that it must be confined to the pipeline, for example, so that it can be maintained at high temperature. The usual approach to a problem of this nature is to apply the differential pressure to a diaphragm-operated force balance pneumatic transmitter mounted adjacent to the tapping points in the pipeline; the diaphragm has virtually no displacement so there is no forward and backward flow of the metered fluid under changing rate of flow conditions. All makes of pneumatic transmitters of this type are now designed to give a 3 p.s.i. to 15 p.s.i. output pressure, 3 p.s.i. being equivalent to zero differential pressure, and 15 p.s.i. to maximum differential pressure, *i.e.* maximum rate of flow. The output from the transducer is measured by a pressure responsive instrument of conventional design, calibrated in terms of rate of flow. These receiving instruments also can give any desired form of presentation and can be fitted with alarms and controls. Electrical transducers, *i.e.* those giving an electrical output instead of an air pressure, have also become available in recent years.

The appearance of these transducers has greatly widened the scope of differential pressure type flow meters. Transducers are available with stainless steel bodies and can be fitted with stainless steel diaphragms or diaphragms coated with a corrosion-resistant substance such as Teflon. They can also be maintained at a reasonably high—or low—temperature.

Another advantage of this form of metering installation is that similar transducers giving a 3 to 15 p.s.i. can be used in association with other measurements such as level, pressure, temperature, *p*H, etc., so that all

registering instruments are of identical form and they can all be mounted at a distance from the individual measuring points, *e.g.* mounted on a central control panel. On the other hand, the introduction of such a transducer into the metering system does increase the capital cost.

Variable area meters

There are a number of fluids, such as hydrochloric acid and wet chlorine gas, which cannot satisfactorily be applied to a transducer of the form described without additional protection. Also there are many applications where the flow rates to be measured are too low for commercially available differential pressure flow meters. In such circumstances a variable area form of meter may be used. In principle the operation of meters of this particular type is the reverse from that of the differential pressure meter, since the differential pressure is maintained constant and the aperture varied. The variable aperture is obtained by passing the flow vertically through a tapered tube, the smallest cross-section being at the bottom and the greatest at the top. The tapered tube contains a float which takes up a position of equilibrium where the differential pressure produced as the metered fluid flows through the annular orifice formed between the rim of the float and the wall of the tube balances the constant apparent weight of the float.

In its simplest form a glass tapered tube is used, the float serving as an indicator which is read against a scale etched in the glass tube (Fig. 2). Water flow rates as low as 0·5 c.c. per min. can be measured by this means.

For larger sizes and where different forms of presentation are required, *e.g.* recording and integration and perhaps automatic control as well, metal taper tubes are used, with magnetic or electric induction transmission between the float and the exterior mechanism. When the magnetic transmission system is employed the float movement is converted to a 3 to 15 p.s.i. air pressure by a position-balance transducer, the 3 to 15 p.s.i. air pressure being registered in terms of rate of flow on an identical form of instrument to that used with differential pressure pneumatic transducers. When the electric system is used, the output is measured by an electrical

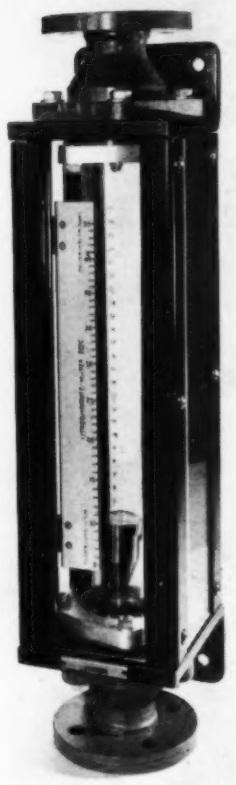


Fig. 2. Variable area flow meter with glass tapered tube. (Rotameter Mfg. Co.)

receiver—usually of the electronic null balance form.

The tapered tubes and float are available in a wide variety of metals and plastics to suit the properties of the metered fluid, together with specially shaped floats to render them less susceptible to viscosity effects.

In addition to the advantage of a wide choice of constructional materials, and the possibility of measuring low flow rates, a feature is the fact that the metered fluid is at all times confined to the pipeline and the system is completely sealed. Another advantage is that since the rate of flow/float movement relationship is linear, a longer flow range can be obtained than with differential pressure flow meters.

The correction factor for variable area meters for change in density of the metered fluid is of the same general form as for differential pressure flow meters. However, if the float can be designed to have twice the mean density of the metered fluid—and this is sometimes possible in suitable circumstances when metering liquids—over quite a wide range of variation in the density of the metered fluid, for all practical purposes the meter will always register the correct rate of flow in *weight* units.

Electromagnetic meters

There still remain a range of fluid substances the flow of which cannot be measured satisfactorily by either differential pressure or variable area meters. Among these are slurries and an increasing number of synthetic materials which do not obey the hydraulic laws of turbulent flow, and, until recently, it was virtually impossible to obtain a continuous measure of the rate of flow of these.

An important step forward in the solution of such metering problems has been made with the electromagnetic meter, which works on the principle that when a conductor of electricity moves through a magnetic field it generates an electromotive force which is proportional to the velocity of the conductor.

The electromagnetic meter consists of a flow tube of a non-magnetic material such as austenitic stainless steel, or fibre glass, etc., depending on the application, which replaces a short length of the pipe through which the liquid to be metered is flowing (Fig. 3). An electromagnet produces the magnetic field and the flowing liquid constitutes the conductor. The voltage generated by the liquid is picked up by two small electrodes, the faces of which are diametrically opposite each other and flush with the inner wall of the flow tube. A minute voltage is generated so that it is only by virtue of the recent developments in electronic equipment that it is possible to accurately detect and amplify the voltage to a sufficient degree to enable it to be applied to an electrical measuring instrument which displays the voltage in terms of rate of flow. By using an electronic instrument of null-balance form, the rate of flow can be indicated, recorded and integrated and the instrument can be used for automatic control purposes.

A meter of this description is not influenced by the viscosity of the metered liquid or its density, neither is it affected by disturbed hydraulic conditions, so that, under all circumstances, it will give a reading which is directly proportional to the

Fig. 3. Electromagnetic flow meter tube. (Foxboro-Yoxall)

true mean velocity of the flow, *i.e.* under all circumstances it will register the true flow in *volume* units. A limitation is that the metered fluid must have a certain minimum electrolytic conductivity, which means that it cannot be used for metering gases or petroleum products. It will be noted that by making the bore of the flow tube coincident with that of the pipe, no additional resistance is caused to the flow, and since the meter has a linear characteristic a long flow range can be obtained. Unfortunately, flow meters of this description are very much more expensive than any other type. Flow tubes for meters of this description are available down to ½ in. bore, and commercially, the lowest maximum velocity of flow is of the order of 1 ft. per second. By using an electronic counter it is possible to accurately measure rapidly pulsating flows.

Ultrasonic type

In recent years interest has been shown in the application of ultrasonic vibrations to the problem of flow measurement.* A number of systems have been proposed for detecting rate of flow by this means; they all depend for their operation on the apparent change in the velocity of propagation of sound waves in a fluid with change in the velocity of flow of the fluid. For example, if a pulse of ultrasonic energy is projected diagonally across a pipe, the difference in the time it takes to traverse the pipe from the upstream transducer to the downstream one, and the time it takes to traverse this path in the reverse direction, will be proportional to the velocity of flow of the fluid. Among alternative methods which may be employed is that of phase difference.

It will be appreciated that electronic equipment is essential to produce the ultrasonic vibrations, which may be in the megacycle range, and to measure the resultant output and translate it into terms of rate of flow.

In view of the number of practical difficulties involved, as yet there is no commercially available flow meter of this description.

In many respects the ultrasonic meter is complementary to the electromagnetic meter. Its application is not limited by the conductivity on the metered fluid but, on the other hand, its output is influenced by changes in velocity distribution across the pipeline.

Mechanical type flow meters

In industrial processes batch quantity control is of importance, calling for a counter record of quantity of liquid passed rather than an indication and record of rate of flow. For this form of measurement a " mechanical " meter is more suitable. That is to say, a meter containing an element which moves at a speed which is directly proportional to the flow rate, the number of cycles being totalised on a circular or cyclometer counter. All quantity meters working on this principle fall into two major groups, inferential and displacement. In the former, the moving element consists of a rotor, *e.g.* in the form of a propeller, which rotates at a speed directly proportional to the velocity flow. In the latter, the moving element consists of a piston having a reciprocating or semi-rotary movement the cyclic displacement of which is directly proportional to the volume passed during each cycle. In general, displacement meters can meter accurately down to lower flow rates and certain forms, especially if calibrated *in situ*, can give accuracies to within a fraction of 1%. However, their use is limited to clean liquids; they are not suitable for gases.

The most highly developed quantity meters for industrial work are of the semi-rotary piston displacement form, with working chambers and moving parts being made of stainless steel, acid-resistant bronze or other similar alloys, and with magnetic transmission to eliminate glanding troubles. Among the liquids which can be metered by this means are acetaldehyde, ethyl compounds, and trichlorethylene (acid resisting bronze), ammonia, nitrobenzene and 75-89% sulphuric acid (cast iron and mild steel), fruit juices and tartaric acid (stainless steel), and so on. In certain conditions it is also possible to meter such liquids as hydrofluoric acid and oleum.

In recent years, with the development of automation, a wider use has been made of meters of this form for batch mixing and similar processes. In principle, the measuring pointer is set to zero on the meter dial and a " desired value " pointer to the dial reading representing the quantity to be passed. On operating the lever of a valve working in conjunction with the meter, flow will take place, the valve closing automatically when the measuring pointer position coincides with that of the desired value pointer. The total quantity passed over a number of such operations may be registered on a cyclometer counter. By transmitting the meter readings electrically to a central panel quite complicated automatic batch mixing systems can be devised, with pilot light signalling and push button control. Meters of this description are available for pipes down to ½ in. bore, the smallest graduated dial division being of the order of 0·01 gal.

Mass flow measurement

A disadvantage which applies to all forms of continuous flow meters is that, apart from the variable area meters (and these in only exceptional circumstances), they will not automatically correct for changes in density of the metered fluid; as indicated earlier in this article, the form of meter least susceptible to density variations is that employing the differential pressure principle. Therefore, an important step for-

* See, for example, R. E. Fischbacher *et al.*, "Symposium on Flow Measurement," *Trans. Soc. Instrument Tech.*, 1959. **11,** (2).

ward in the art of flow metering will be made when a true " mass flow " meter for general industrial use is developed. Attention is drawn to the fact that for metering fuel on aircraft true mass flow meters are available, since under modern conditions, especially with jet aircraft, mass flow measurement is imperative. However, such meters, involving the use of a power-driven rotating element, have only been developed for this particular application and they involve quite complicated mechanism, which make them expensive.

Automatic flow control

In its simplest form an automatic flow control installation is one in which the instrument registering the rate of flow is fitted with a device, such as two pairs of electric contacts, with a " dead " zone between them so that when the flow rate exceeds a certain value one pair of contacts is closed, the resulting impulse having the effect of stopping or reducing the flow, *e.g.* by throttling a control valve, the reverse effect occurring when the flow rate falls below a certain lower value, when the second pair of contacts are closed. Various modifications of this simple system are possible but, to a certain degree, they all result in an oscillation or " hunting " in the rate of flow.

Modern process techniques frequently call for very much closer automatic control conditions where, under varying conditions of supply and demand, virtually constant flow rate conditions must be maintained. There are also applications in which the ratio of rate of flow between two or more different fluids must be maintained constant irrespective of variations in the rate of flow of one of these.

At present most advanced forms of controlling units are pneumatically operated. Irrespective of the mechanical details of these, the basic principle of operation is the same; by using a negative feed back system null balance operation is achieved. A signal proportional to the rate of flow is fed into the controlling unit where it is compared with a signal proportional to the desired value of the rate of flow. Any difference between the values of the two signals, representing a deviation, is amplified and fed to a regulating unit, *e.g.* a diaphragm-operated control valve which is moved in the direction to reduce the deviation to zero. Thus, if the flow rate is tending to increase

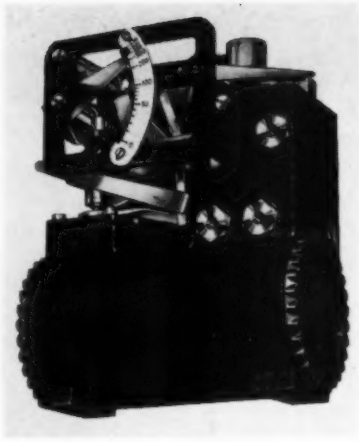


Fig. 4. Position balance pneumatic controlling unit showing proportional band scale. (George Kent)

above the desired value, the corrective signal, expressed as an air pressure, would change in the direction to cause the valve to close and throttle the flow. This signal is also fed back into the controlling unit to bring the mechanism of this back to its original, balanced position.

The simplest control action is " proportional " and in this the signal to the regulating unit is always proportional to the deviation. Thus, under changing load conditions, there is a constant deviation between the actual and desired flow values, the magnitude of which depends on the change in load. However, by the addition of an " integral " control action, which has the effect of continuously altering the signal to the regulating unit in a manner related to rate of deviation, coincidence is maintained between the desired and actual flow values. A third, " derivative," control action can also be used in addition. This action gives a corrective signal directly related to rate of change in deviation. The effect of all three control actions can readily be altered individually over a wide band, thus enabling the flow controller to be " tuned " on site to suit the individual circumstances. Automatic flow control is one of the simpler control problems encountered in industry and when properly applied can maintain a constant rate of flow under widely varying conditions, *e.g.* pressure fluctuations within the plant.

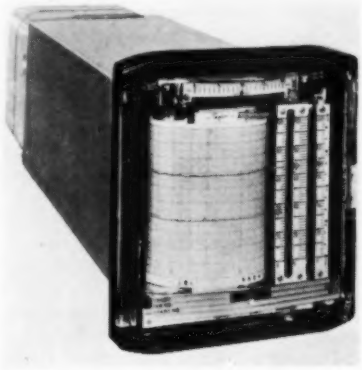


Fig. 5. Miniature 3 to 15 p.s.i. receiver / recorder / indicator / controller. (Taylor Controls)

The position balance form of controlling unit consists of a small mechanism which can readily be attached to a conventional form of flow registering instrument (Fig. 4). The desired value pointer on the instrument positions one side of the controlling unit, and the actual value pointer, the other side. Through a differential link, any deviation between the two pointers alters the position of a small baffle relative to the outlet of a nozzle which is fed with compressed air and discharges into the atmosphere. This changes the air pressure within the nozzle system and consequently the output air pressure signal to the regulating unit, and, via a bellows unit or similar pressure responsive device, re-positions the baffle; the overall movement of the baffle is of the order of a few thousandths part of an inch. As in the case of differential pressure transducers—as well as other forms of pneumatic transducers—the overall output air pressure from the controlling unit to the regulator is now standardised at 3 to 15 p.s.i.

Especially in large and complex process control installations, as indicated earlier in this article, it is now the common practice to utilise the appropriate forms of transducers so that all rate of flow variables—and others as well—are converted to a 3 to 15 p.s.i. air pressure and transmitted to a central point where they are registered in the appropriate units on miniature pneumatic receivers (Fig. 5). For automatic control purposes, force balance controlling units of stack construction are used working in association with the receivers. The general principle of operation of these is as described when dealing with position balance controlling units, but in this instance diaphragm units working in

(Continued on page 264)

The new building lies on the edge of the Welwyn Garden City industrial area in a site of 9 acres. Extensive use is made of red brick and concrete.

The SKF Laboratories at Welwyn

APPROXIMATELY 70,000 sq. ft. of the new £1 million building of Smith Kline and French Laboratories Ltd. at Welwyn Garden City are devoted to production. This is nearly half of the total area and in addition there is an animal house of 8,000 sq. ft.

The company's fine chemical factory is at Tonbridge, Kent, and it produces 80% by value of all Smith Kline and French products. At Welwyn, finishing processes are carried out.

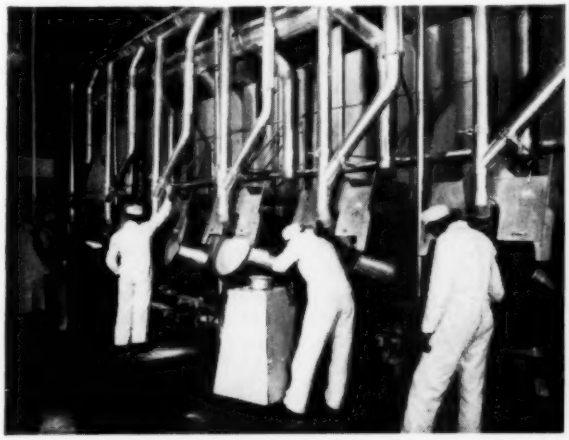
Technically the most interesting process at Welwyn is the manufacture of pellets for sustained release products, *Spansules*, as they are called. The object is to produce pellets which will dissolve at different rates in the body, thus releasing a drug at an even rate over a period. The products include phenobarbitone, *Dexedrine*, *Drinamyl* and *Histryl*. The pellets are extremely small, no bigger than the "hundreds and thousands" used for decorating cakes. They are built up in much the same way as these confectionery pellets. The core is a single seed of caster sugar which is gradually built up in a revolving pan by the successive application of sugar and syrup. Different colours are used to identify the pellets. *Spansules* are packed in rigid gelatin capsules and the contents are blended to provide a drug release rate within the tolerances specified for the product.

Creams, ointments and liquids are produced in a well-equipped department which includes four stainless steel tanks and vats, each of 2,250 litres capacity. After mixing the products, *e.g. Neurophosphates*, *Eskamel* ointment, *Furacin* solution and *Pragmatar* cream, are transferred by pipeline to the packing department. Here the usual automatic machinery is used to keep up a high rate of output. The other major production department is tablet manufacture. Here there is a wide range of tableting machines, mixers, granulators, steam-heated drying ovens, comminuting mills and coating pans.

In the packing and dispatch department, orders are dealt with at the rate of nearly 1,500 a month. Goods in bulk are forwarded to every part of the world. The company does about £1 million p.a. overseas business, approximately one-third of the total turnover.

There are extensive research and control laboratories in the new building. There is a process development section for scaling up research

(*Continued on page* 264)



(Left) These coating pans are used for the long and slow process of building up sustained release pellets, the core of which is a seed of caster sugar. (Right) The tablet manufacturing department.

MEMOIRS OF AN INDUSTRIAL CHEMIST

By M. L. Burstall, D.PHIL.

3. Recruiting Research Talent

To round off his somewhat irreverent trilogy on industrial research, Dr. Burstall considers the motives and methods of companies seeking research staff and the ambitions and talents of people seeking jobs in research. He offers suggestions to both hunters and hunted. His first article—"How to make Research Pay"—appeared in February and his second—"Why Industry should do as little Fundamental Research as Possible"—in April.

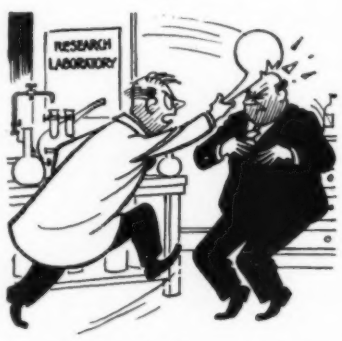
IN THE recruiting season, when the annual big-game hunt is in full swing, managers and would-be recruits match move with move in that most complex and fascinating of all games. It owes both its fascination and its complexity to the large number of difficult yet vital decisions which the players are forced to take: What sort of man do we want? How do we get him? How high should we go? or, from another point of view: How do I get picked? What qualities must I have? Can I do better elsewhere? As I have been on both sides of the table in the not very distant past, I feel that I am in a peculiarly suitable position to suggest answers to some of these questions, and to offer a few words of advice and encouragement to all concerned.

How should a company go about recruiting for its research establishment? At the risk of seeming intolerably obvious I urge all companies who are about to plunge into the jungle in search talent of to decide very carefully what they should be looking for. This will depend initially on their attitude to research workers. A few companies look on their research departments as a sort of nursery school in which the newly-recruited academic may be gently acclimatised to the industrial atmosphere before he is pushed into the ruder world of sales or production. In view of the rather different qualities required by successful research workers and, say, successful plant managers, it would be most interesting to know how far, and in what ways, this policy is satisfactory. It may be significant that, according to the grape-vine, one large company which has followed this policy for some years has recently abandoned it.

Most companies, however, recruit research workers to do research. The major strategic problem of recruiting is then to decide the kind and number of workers required by the company's research programme. This should depend almost entirely upon the nature of the programme. Thus, for example, product research usually requires large numbers of semi-skilled technicians but relatively few technically qualified workers, these latter being for preference well-versed in the design and organisation of large-scale evaluation procedures rather than in the more usual disciplines. Process research, on the other hand, calls for considerable numbers of rare—and therefore expensive—chemical engineers, and fundamental research similarly requires both highly-trained graduate specialists and highly-trained technicians. In the same way suitable conclusions may be drawn about the normal demands of other types of research.

Put in this way it all sounds very simple. Yet in practice even the best companies seem to blunder all too frequently in making these decisions. Having talked to many disillusioned young industrial chemists, I have come to the conclusion that the following errors of strategy are so common as to be the rule rather than the exception:

★



". . . Resign in circumstances of dramatic unpleasantness . . ."

1. Recruiting too many qualified research workers. There is a general tendency for companies to recruit able research workers without much regard as to whether they can be given work appropriate to their abilities. In consequence many find themselves doing jobs which could as well be done by technicians, while others may even be compelled by necessity to invent projects with which to fill their working day. I have often wondered if those companies which have been mentioned to me as being particularly notorious for their misuse of scientists in this way are among those which regularly go on record as considering that the nation's output of trained research workers is grossly inadequate.

2. Recruiting the wrong kind of research worker. This error may take the form of recruiting specialists of the wrong sort, or more commonly, of recruiting specialists when potential all-rounders are actually needed. As a result many new recruits find themselves, often to their considerable surprise, assigned to problems in which they have no interest and which they are not trained to solve. Sometimes this seems to be a deliberate policy, as is suggested by the remark of a friend of mine that his company apparently thought that any new recruit could become an expert on anything in one month flat; he added that this company, perhaps not surprisingly, considered any one of its own experts to be automatically inferior to any outside expert in the same field. It may well be thought that if a company wants

specialists it should recruit specialists; if it wants all-rounders, then it should recruit all-rounders.

The result of these blunders is that many research workers become bored and frustrated; inevitably many of them resign, sometimes in circumstances of dramatic unpleasantness. From the company's point of view, the tragedy is that it is the most able and the most energetic who are the most likely to leave.

What is the cause of these mistakes? One cause is sheer managerial inefficiency. The useful idea of job description has not yet reached many research departments; and research managers, partly through caution, and partly, I suspect, because many of them have forgotten what a really efficient research organisation looks like, have a marked tendency to overestimate the magnitude—and therefore the manpower demands—of their research programmes. It also seems that they are not in general very good at deciding whether their problems call for specialists of a particular kind; sometimes they change their minds on this point with the distressing results described previously. Another cause, especially potent in large firms, is the excessively bureaucratic organisation of research; in such circumstances, the operation of Parkinson's Law produces a steadily increasing number of pointless positions to be filled, regardless of the amount of work—if any—done by the department.

My own observations lead me to suggest another and even commoner cause: the plausible, widespread and highly erroneous idea that a company should always possess rather more research talent than it can fully use, so retaining a strategic reserve, as it were, against such future contingencies as the appearance of more difficult problems, the expansion of the research programme, or a sudden call for men suitable for promotion. This policy has obvious attractions for research managers and it leads, not infrequently, to a policy of recruiting the largest possible number of the most outstanding chemists available. The only trouble with this policy is that it does not work. Able research chemists cannot be put into cold storage until wanted as if they were so many packets of frozen beans; if for any reason they are not given problems worthy of them, they either become frustrated and leave, or tend only too often to deteriorate

". . . Put into cold storage until wanted . . ."

★

rather rapidly. Moreover, the promotion of one out of a group of gifted young research workers may make for severe tensions within the group, especially if, as is often the case, the bait of rapid promotion has been used to recruit them all in the first place. I once asked a research manager whom I met socially how he dealt with this last problem. " It never arises," he replied easily. " We lose enough new people anyway to leave only one or two experienced enough for promotion when a vacancy turns up." To paraphrase the American saying, this is a hell of a way to run a research department.

I would therefore suggest that all companies should start their recruiting drives by deciding how many research workers they really need, and how gifted they should be and in what ways. I would also suggest that they think very carefully before recruiting very bright men unless they have jobs that need such men.

The qualities desired

The strategy of recruiting involves in addition to these particular questions a more general problem: what are the qualities which indicate that an individual will be, at any level, a good research worker? To judge from the recruiting literature I have read and the talks I have heard, the ideal industrial research chemist should look something like this: he should be intelligent, hard-working, inventive, ambitious and versatile, and should have a first-class honours degree and Ph.D. from one of the older—or larger—Universities. Although under 30 years of age, he should be mature, emotionally stable, a good mixer, and in all things a good loyal team player.

It would indeed be a miracle if all these qualities and attainments were to be found in a single man, and the age of miracles is past. In practice one is forced to choose between men who all lack some of them. To which qualities should one give most weight? In the absence of the necessary scientific investigations into the make-up of successful research workers, I venture a few suggestions based purely on my own experiences. Bearing in mind what I have already said about different types of research making different *intellectual* demands, I think that the most useful *general* qualities that an industrial research chemist can possess are drive, originality, and versatility.

By " drive " I mean that curious ability to get results in the face of difficulties which some people seem to possess. It appears to be a mixture of the ability to work hard oneself and to stimulate others into working hard, and the ability to overcome obstacles by a flexible approach if they are technical in origin, and by persuasion, manœuvre, or if necessary by brute force if they are human in origin. There is a good deal of inertia in all organisations, and a lot of drive is necessary if progress is to be made.

By " originality " I mean that the research worker should have an essentially irreverent mind that will not accept readily—if at all—the necessary perfection of existing products and processes. In practice this is not a very popular talent with research managers, who like a quiet life, but it is the source of innovation.*

By " versatility " I mean a genuine interest in everything that could remotely bear on the company's interests; in practice this means an interest in the whole of science and commerce. Again, this is not a popular talent; it is thought by those of duller minds to be characteristic of the dilettante; but it is essential to anyone who is expected to work, as are most industrial research chemists, on many different problems, and to see, as surely all should try to see, any potential profit in an apparently useless piece of research.

I do not think that research workers need to have more than a fairly low minimum ability to get on

* Anyone who possesses this characteristic will soon find his superiors accusing him of " destructive " criticism. " Destructive " criticism is criticism that hurts the management's feelings; by definition therefore any substantial criticism is destructive and is therefore deprecated.

with other people. It is nice if they are well endowed in this respect, but it is not necessary. The function of a research department is, after all, to produce profitable innovations. Providing it does so, it is irrelevant whether it is a haven of calm or an emotional storm-centre. It is, moreover, worth pointing out that good research workers usually have strong, and occasionally downright unpleasant, personalities. It is foolish not to recruit such people; it is naïve to expect a department which contains many of them to be other than bracing in its atmosphere; and it is ridiculous to insist on the preservation within the department of a non-existent harmony. To the European eye, the most dismal aspect of American industrial life is the fantastic waste of time and effort in the attempt to repress controversy and to brainwash the individual into conformity. It would be a disaster if British companies were to follow this futile pattern.

The market for talent

So much for the aims of recruiting. Let us now take a look at the market in which companies are buying. The demand for research chemists follows in practice a fairly well-defined pattern which is not usually obvious to the graduate student travelling in temporary affluence from one interview to another. The first point that should be made is that most companies are looking for *young* men; it is significant that most advertisements for all but the most elevated positions specify a maximum age limit of 30 or at the most 35. It seems likely that this trend will become even more pronounced in the future because of the increasing popularity of the policy of " promotion from within," in which only the lowest level of positions are filled from outside the company; inevitably this means that only very young men are recruited. Secondly, most companies are, whether they realise it or not, looking for potential all-rounders. There are few long-term posts in industry for specialists as such; the only exception is the necessarily limited demand for certain kinds of instrumentalists. Lastly, there is an increasing tendency to demand formal post-graduate qualifications from all would-be research workers; we seem to be approaching the American situation in which no-one without a Ph.D. is allowed to touch a burette or run a panel test. That any or all of these may well, in view of what I have previously said, be mistaken, is beside the point: they mean that in practice the market for research workers is very largely a market for young, versatile, graduate students.

How much use are these people to industry at the time they are recruited? My own impression, based both on formal interviews and on observation of them in their native habitat, is that they are very largely untrained for industrial research. Almost all are reasonably competent in their speciality, a fair number can remember some general chemistry, and usually one or two have heard of a standard deviation; but they are reluctant to read, they cannot write, and not more than one in ten has the slightest idea of how to tackle the sort of problem which is outside his own immediate experience. Indeed one is left with the feeling that whatever the other failings of University education in Britain, it could scarcely be accused of being excessively utilitarian. This does not matter much as far as the able are concerned—they are usually versatile, and they will soon grasp the realities of the industrial situation—but it must be realised that the increasing emphasis on the necessity of having a doctorate together with the large number of post-graduate grants now available means that some fairly mediocre people are now taking—and getting—the Ph.D. In order to do this, these unfortunates have to work excessively hard, and they tend to become narrow in their interests and rigid in their attitudes, sometimes to the point of becoming, by any objective criterion, almost unemployable. In my opinion there is a strong case for Universities instituting a one- or two-year course in the methods of applied research; such a course would include a generous dose of statistics and experimental design, and some economics, and might finish with an experimental project designed to be completed in, say, six months. Such a course, especially when combined with a year's academic research under some such system as the Oxford Part II in chemistry, would offer a very useful alternative to the Ph.D. for many would-be industrial research workers, to say nothing of the benefit to industry itself.

Talent outside the Universities

It thus appears that when a company recruits straight from the University it is recruiting potential rather than actual talent, and so takes an additional risk. This risk, however, is inevitable as long as companies insist on neglecting the sources of research workers *within* the industry. The principal of these is, of course, the research workers in other companies. It is surprising that so many otherwise enlightened firms acquiesce in the maintenance of barriers to the free movement of chemists when it is by no means obvious that it is in their interest to do so. The most important of these barriers are the system of non-transferrable pensions, the odious practice of some firms of agreeing not to hire each others' employees, and our old friend " promotion from within." Their effect is to make it difficult and often impossible for anyone aged over 35 to change his job. There does not seem to be much chance of improving this situation; it seems that for most companies the joys of owning a captive work force and of preserving that comfortable *status quo* outweigh the improvement in the quality of research that comes from constantly bringing fresh—but trained—minds to bear on their problems.

The second neglected source of research workers is the technicians. A significant minority of these have the potential to rise from the ranks, as it were, and they should be given every encouragement to do so; the snobbery endemic in many University graduates should not be allowed to blind us to the fact that many technicians are men of excellent quality who have missed, because of domestic circumstances or because they matured too late, their chance of a University education Even among the less gifted, moreover, there are many who with training and experience can be relied on to carry out large parts of most investigations without much supervision. Having worked in a company which followed an enlightened policy in this respect with great success, I feel very strongly that other companies should do likewise.

Methods of selection

How does one find the man one wants? There is one almost infallible method that, regrettably, has not yet commended itself to any British company as far as I know. This is to pick research workers entirely at random, to subject them to a battery of the most diverse tests, and finally, after a suitable period of time, to assess their actual research per-

formance on, if possible, problems of a comparable type; the tests which correlate most closely with performance are then used for selecting future recruits. It seems a pity that no company is bold enough to try this approach, as it would pay obvious dividends, and I can think of several companies that could hardly do much worse during the period in which the validity of the tests was being established than they are doing already. The whole idea of tests, however, is somewhat under a cloud. Most companies have dropped intelligence tests for candidates for staff positions because of the resistance of the candidates themselves, who made it very clear that they considered such tests to be strictly for the peasants. Personality tests and tests of "creativity," never widely used in this country, have got a deservedly bad name in the United States, mainly because most companies used inadequate tests administered by incompetent people. Nevertheless the development of more scientific methods of personnel selection seems to be a promising field for future research.

For the time being, however, most of us have to fall back on the traditional routine. Paper qualifications are examined, candidates are briefly examined on their home ground, and then, if they show promise, at greater length at the company's research headquarters; finally the hook, suitably baited, is offered, and either swallowed or ignored. It is difficult to assess the adequacy of this process; the general consensus of opinion in the more intelligently-run companies is that it is fairly good providing that it is carefully carried out. Paper qualifications are often very informative—thus there is a very high correlation between ability at pure research and possession of a first-class honours degree of the University of Oxford*—and at least enables one to screen out the obvious duds quickly and painlessly. The interview can also be useful if carried out by the right person. As we all know, interviewers always look most kindly on people like themselves—I must admit to a weakness for enthusiastic talkers with a predilection for radical solutions—and, of course, the very nature of the interview favours the candidate who can talk clearly and fluently. Nevertheless it is at least arguable that the ability to make a good impression in a series of interviews suggests quick wits, versatility, and a talent for communicating with others and, other things being equal, these are desirable qualities in an industrial research worker. The interview is also a convenient place for that frank exchange of views which is necessary if misunderstandings are to be avoided, but which is best not committed to writing. I am in favour of most of the interviews being conducted by people who have joined the company fairly recently. From the company's point of view they have the advantage of being closely in touch with chemistry and are therefore better suited to judge the candidate's ability than those farther up the line; moreover, since they will have to work with him, it is as well that they should see him before he joins the company. From the candidate's point of view they have the advantage that they know how the company's policies on such matters as promotion, bonuses, publications and so on work out in practice, and a skilful questioner can form a more balanced picture of the company's merits and demerits than he would from the answers of a more senior—and therefore officially more optimistic—person. For the convenience of people inexperienced in the art of interviews I include a few rules which I have found to be useful in saving both time and tempers:

". . . A weakness for enthusiastic talkers . . ."

★

Rules for interviewers: Let the candidate do the talking. Don't ask him about his thesis; at the thought of talking about it yet again he may vomit. Don't ask him about his hobbies as these are hardly ever either amusing or informative. Try to be balanced in your account of work and conditions in the company; don't shout your message too loudly as this merely irritates. Above all, be truthful and don't make any promises that can't be kept.

Rules for candidates: Be natural; avoid any suggestion of either superiority or of an excessive desire to please. Don't lay claims to any knowledge or talent which you do not in fact possess. Don't waste time on trivialities; you can't spare it. If you are being interviewed by someone of near your own age you may be frank about your own motives, expectations and other offers of employment, as this will help both of you. Don't ask senior people about pension schemes; these are all much the same, and it is one of the shibboleths of industry that a candidate should not be security-minded. Large companies run on Civil Service lines feel particularly strongly about this.

Inducements

Lastly, having found the right man, what inducements can be offered him? Curiously enough, few companies make any effort to attract research workers by offering high salaries. Companies are, of course, very reluctant to disclose the details of their salary policies; my own network of agents report, however, that the starting rate for a Ph.D. is—and has been for several years now—between £850 and £1,050 per annum. These rates vary with the age rather than the ability of the research worker, and do not vary much between companies. It appears indeed that most companies fix their pay-scales by reference to what other companies are paying. This suggests that, contrary to their frequent public statements, companies do not feel that there is any very desperate shortage of research workers; if they did, then the market price would rise much more sharply than is the case. It is not surprising to find that those chemists who are motivated mainly by money prefer to go to North America, where a Ph.D. can be reasonably sure of starting at $8,000 per annum, which in purchasing power is equivalent to about £1,800.

Other inducements may be useful. Much the most important of these is being able to offer interesting work; many chemists will cheerfully accept a smaller salary if this can be guaranteed. Unfortunately this is

(*Continued on page* 256)

* But *not* with possession of a first-class honours degree of the University of Cambridge. See Hudson, *Brit. J. Psychol.*, Feb. 1960.

COSMETICS and Toilet Preparations

By W. W. Myddleton, D.SC.

Sunscreens and sun-tans ● Acceleration of suntan by psoralens ● Further work on preservatives ● Synergists for antiseptics ● Antioxidants and synergists for antioxidants ● Behaviour in emulsified systems.

This sunbathing business

DEVOTEES of sun-bathing are again making plans for acquiring a deep and lasting tan with the minimum of discomfort and with the assurance of eliminating reddening, blistering and peeling of the skin. There are preparations which help to this end, some with well-established reputations. In general these lotions or creams are applied all over the body and serve to screen the skin from the ultra-violet light of wave lengths which are known to produce rapid and painful sunburn; they are in fact selective light filters.

Some of these preparations aim to cut out practically all of the rays of lower wave length which are active in damaging the skin and allowing the longer waves to pass through to the skin, where they produce a superficial skin-tan which is not very permanent and not very deep in colour. The deeper, more desirable tan is produced by the injurious rays which, by virtue of the cosmetic lotion, may be so far screened out that the erythema they cause is slight. The lotions in fact allow the sun-bather to bask in the sun for long periods and so develop a deeper tan. Exposure must of course be gradual so that the slight erythema produced is not allowed to develop unduly.

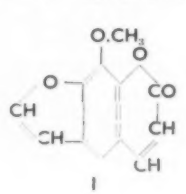
It would appear that some erythema is essential to the formation of the deeper tan, and a point of great importance is that the pigmentation arising from it is formed in the basal layer of the epidermis where it cannot protect from damage the prickle cells lying above it, a damage which in fact constitutes sunburn. It is some time later that the pigment granules formed work their way outwards and serve to give the desired appearance of sun-tan and to protect the prickle cells.

Acceleration of sun-tan

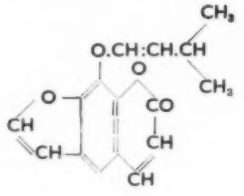
In recent years there has been some interest in the use of the so-called *psoralens* to stimulate the development of pigment under the influence of sunlight. These substances take their name from the Indian plant *psoralea* from which Indian women have prepared and used a toilet water for a very long time. Later, substances were found in the extracts which stimulated pigmentation of the skin in certain deficiency conditions. In 1947 three of these so-called *psoralens* were isolated from extracts of the Egyptian plant *ammi majus* (Linn.) indigenous to the Nile valley and found as an alien weed in the Severn Valley. They were isolated in a pure state and given names made up of fragments of the botanical name of the plant namely Ammoidin, Ammidin and Majudin occurring in the seeds to the extent of approximately 0·5, 0·3 and 0·04% respectively.[1]

Ammoidin was later identified as xanthotoxine, $C_{12}H_8O_4$ (I) m.pt. 148°C.; Ammidin was identified as imperatorin, $C_{16}H_{14}O_4$ (II) m.pt. 102°C., and Majudin was recognised to be bergapten $C_{12}H_8O_4$ (III) m.pt. 189°C.

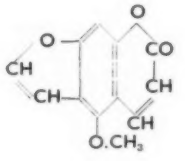
(I) and (II) may be regarded as derivatives of pyrogallol (IV) and (III) as related to phloroglucinol (V).



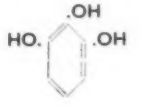
I



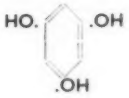
II



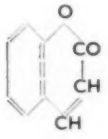
III



IV



V



VI

All three are related to coumarin (VI). All three occur in a number of different plants; Bergapten is present in essential oil of bergamot, from which it separates as a crystalline magma on storage.

The psoralens either singly or in admixture, have been administered orally, by subcutaneous injection or by topical application in an oint-

ment, or lotion, or by a combination of these procedures, followed by exposure to sunlight in many cases where there has been a disturbance of the normal pigmentation processes of the skin.

Vitiligo is an example of disorganised pigmentation in which unpigmented areas of skin appear, sometimes surrounded by patches of deep pigmentation. Satisfactory repigmentation has been reported in about one in seven cases treated and failures have been attributed to local absence of melanocytes in the affected areas.[2] What happens in normal skin cannot be judged by results obtained when abnormal conditions prevail.

Complications have been reported in a number of cases where administration has been by mouth or by subcutaneous injection and side effects such as erythema, vomiting, diarrhœa, hepatitis and nephritis have been noted.[3] In some cases overpigmentation has taken place. When considering these matters it must be noted that untoward occurrences have followed oral administration or subcutaneous injection in cases in which there is a diseased condition. In such circumstances Ammoidin or 8-methoxypsoralen has been described as more toxic than the other two, but a safe dose of this is described as 50 mg. per day for a human adult when administered internally.

The psoralens have been used in aids to sun-tanning in the form of ointments to be applied to the skin for some time before exposure to strong sunlight. Exposure is intended to be in easy stages. The total area of skin to which the preparations are applied are, of course, extensive for a general tanning of the skin. Before the practice can be confidently approved there should be a careful investigation to determine a safe level of concentration and to find out whether such a concentration will have a marked effect in promoting the safe development of suntan. The topical application in the form of a liquid lotion or as a cream requires about one month for the development of an effective tan and exposure to sunlight must be gradual.

The *British Medical Journal*[4] has strongly condemned the practice on grounds mentioned above, uncertainty of action with many failures, and the possibility of untoward side reactions. The condemnation has little relation to the case in which the compounds are to be applied externally in an ointment or lotion without oral administration or injection, and in which the skin is in a normal condition.

There would appear to remain some justification for the careful exploration of the potentialities of the psoralens as cosmetic materials. Such an exploration could best be undertaken by the cosmetic industry, a procedure which could be made much more effective and thorough than sporadic investigation by individual units within the industry.

More work on the preservation of cosmetics

Many of the very numerous investigations of the effect of non-ionic emulsifiers upon the phenolic antiseptics of the *p*-hydroxybenzoate type have been carried out in laboratory culture media in a system much simpler than that occurring in any cosmetic emulsion. From this form of investigation de Navarre[5] concludes that the non-ionic compounds which are formed by condensation of ethylene oxide diminish or inhibit the preservative action of *p*-hydroxybenzoates, and the greater the degree of ethyloxylation the more rapid the inactivation, excepting in the case of the Carbowaxes. Wedderburn[6] has pointed out that the behaviour of the Carbowaxes may depend upon the fact that they are not surface-active agents. In the last mentioned paper the author presents the matter in a somewhat different way by concluding that the degree of inactivation of the preservative increases as the hydrophilic-lipophilic balance (HLB) of the non-ionic surface-active agent decreases.

It is therefore possible for misunderstanding to arise when comparing the conclusions of the two workers. In one case the inhibiting effect is related to the extent of ethylene oxide condensation, in the other to changes in the HLB value of the non-ionic surface-active agent, and this may be brought about either by varying the hydrophobic part of the molecule as in the *Tweens* 20-40-80 or by altering the degree of ethylene oxide condensation, or by a combination of the two.

A very detailed examination is now reported in which the preservation of commercial cosmetic oil-in-water emulsions was studied with the co-operation of the cosmetic manufacturers.[7]

As a preliminary three typical emulsions were prepared with non-ionic surface-active agents and were preserved in one group with a mixture of methyl and propyl *p*-hydroxybenzoates and in another group with sorbic acid. After contaminating the samples separately with six different micro-organisms observations were made over a period of three months. The protection afforded by the benzoates was found to be much more satisfactory than would be anticipated from the results of testing in a less complex system. Where failure did occur the corresponding samples containing sorbic acid at a concentration of 0·2% showed no deterioration.

Eighteen commercial cosmetic emulsions containing the currently used preservatives were compared with a group of samples judged to be of similar formulation in which sorbic acid at 0·2% concentration was used as preservative. Inoculations were made with nine different micro-organisms and observation was again made over a period of three months. Again the performance of the benzoates was better than might have been anticipated from the component tests reported in the literature. Sorbic acid gave complete protection in cases where the hydroxybenzoates failed, with one exception in which a slight mould growth occurred.

The emulsions dealt with in this investigation are all of the oil-in-water type, primarily because the focus of interest lies in the inhibition of preservative action by emulsifying agents containing condensed ethylene oxide which promote this form of emulsion, and secondly because this is undoubtedly the most vulnerable type of emulsion. Growths occurring in creams of the water-in-oil type can often be found to be associated with nutrient foreign bodies such as fibres of various kinds. The oil-in-water emulsion is most urgently in need of study but, at the same time, it must be remembered that some cosmetic emulsions of the water-in-oil type are stabilised by incorporating a minor proportion of an ethylene oxide condensate emulsifier. Water-in-oil emulsions of all kinds are liable to break down slightly at the wall of a glass container liberating a film of aqueous phase which can provide favourable conditions for the proliferation of micro-organisms.

The overall conclusion is that the preservation of cosmetic emulsions containing non-ionic emulsifiers depends upon more factors than a

reaction between the non-ionic surface-active agent and the phenolic preservative and it is therefore necessary to examine experimentally each type of formulation.

Synergists for antiseptics

Mixtures of different antiseptics sometimes reinforce each other and notably mixtures of the esters of *p*-hydroxybenzoic acid have been found to exhibit higher preservative action than the sum of the activities of the components of the mixture, both in the absence and in the presence of non-ionic surface-active agents. In particular the mixture of five esters known as *Nipa* 82121 appears to be an effective combination, and although subject to diminution in activity in the presence of some non-ionic emulsifiers in laboratory culture techniques it behaves more reliably in cosmetic emulsions, as one would expect from the foregoing comments.

Some of the polyols have been observed to enhance the preservative action of the hydroxybenzoate esters and to reduce the effect of non-ionic emulsifiers upon them; several workers have reported the synergistic action of propylene glycol and hexylene glycol in this respect.

Antioxidants and synergists for antioxidants

Five interesting papers dealing with the action of antioxidants and the synergistic agents which increase their effectiveness have recently appeared. In a discussion of the higher gallates as antioxidants[8] a distinction is drawn between the preservation of water-free fats and fats in contact with a water phase, a condition common in cosmetic products. The presence of water reduces the protection afforded by many antioxidants and the cosmetic emulsions present a very large area of contact between water and oil phases. Prooxidative effects are produced by oxygen entrained in the emulsion during manufacture as well as by oxygen absorbed from air in contact with the product. The presence of metallic ions can also accelerate oxidation.

The effect of a water phase may depend upon the *p*H of the phase: on the acid side the presence of water is described as increasing the efficiency of oil-soluble antioxidants such as nordihydroguaiaretic acid (NDGA), *α*-tocopherol and dodecyl gallate. Evidence is quoted which shows that the oil-soluble antioxidants are ineffective when the aqueous phase is alkaline.[9]

The water-soluble ascorbic acid has been used as an antioxidant and also as a synergist to other antioxidants in the absence of water, but when an aqueous phase is present ascorbic acid may even act as a prooxidant. (This effect is probably dependent upon the quantity of ascorbic acid present.) The water-insoluble antioxidant ascorbyl palmitate has, it is claimed, a marked synergistic action upon other oil-soluble antioxidants when the aqueous phase is on the acid side. The reference given in this connection by Peereboom is to the work of Spetsig.[10]

Several synergistic mixtures of antioxidants are now available and they are reported to be effective even in the presence of an aqueous phase (on the acid side) because of their solubility in oil. Antrancine 20 (Naarden Ltd.) contains octyl gallate, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and nordihydroguaiaretic acid (NDGA) along with a synergist which acts as a metal-scavenger. Antrancine 22 (Naarden) is similar in composition but dodecyl gallate replaces octyl gallate.

The work of Spetsig is again quoted[11] as showing that in cosmetic emulsions fat-soluble synergists which may or may not themselves be antioxidants or otherwise metal scavengers should be employed in preference to water-soluble compounds. Such oil-soluble synergists are monoisopropyl and monostearyl citrates, palmityl phosphate and ascorbyl palmitate.

The First Documentary Edition of the *American Perfumer*, in which the above papers appear, covers a wide field in an authoritative manner. There are sections on household specialities, pharmaceutical cosmetics, preservatives and antioxidants, commercial surfactants, aerosols and cosmetic emulsions.

REFERENCES

1. I. R. Fahmy and H. Abu-Shady, *Quart. J. Pharm. and Pharmacol.*, 1947, **20,** 281.
2. A. Jarrett and G. Szabo, *Brit. J. Derm.*, 1956, **68,** 313.
3. A. S. Sheldon *et al.*, *AMA Archives of Dermatology*, 1956, **74,** 9.
4. *B.M.J.*, 1958, (**ii**), 1212.
5. M. G. deNavarre, *J.S.C.C.*, 1957, **8,** (6), 379.
6. Doreen L. Wedderburn, *J.S.C.C.*, 1958, **9,** (4), 216.
7. R. D. Charles and Phyllis Carter, *ibid.*, 1959, **10,** (6), 383.
8. J. W. C. Peereboom, *1st Documentary Edition, Amer. Perfumer and Aromatics*, p. 114.
9. Sandell and Spross, *Svensk. Farm. Tidsk.*, 1950, **54,** 69.
10. Spetsig, *Svensk. Kem. Tidsk.*, 1952, **64,** 191.
11. Spetsig, *Acta Chem. Scand.*, 1954, **8,** 1646.

RECRUITING RESEARCH TALENT

(*Continued from page* 253)

often not possible. Offers of rapid promotion are less useful; every veteran of the Grand Tour knows that all companies are expanding rapidly—according to themselves if no-one else—and that there are always plenty of opportunities for that mysterious creature " the right man." The location of the research laboratories is not unimportant; companies offering work in the South of England* generally find it easier to attract people than those situated in less favourable situations. On the whole, though, the salary and the type of work offered appear to be the most powerful considerations in coming to a decision.

* * *

In concluding this series of articles, I would like to repeat that my motive in writing them has not been to mock or to disparage the ways of industry—I owe too much to at least one of my former employers to do this—but to stimulate thought about the aims and methods of industrial research. I hope that by presenting an unfamiliar point of view I have succeeded in doing so.

* To a large part of the graduate population of this country the North of England is deemed to begin at Potters Bar. By this reckoning, Newcastle-upon-Tyne is well within the Arctic Circle.

Chemical catalogue. The 1960 catalogue and price list of chemicals and reagents for research and analysis issued by Hopkin and Williams Ltd. runs to 278 pages. The usual high standard of printing and binding has been maintained and the catalogue is a valuable book of reference. The entries are alphabetically arranged in five sections: organic and inorganic chemicals, reagent solutions, microscopical stains and reagents, silicones, British Chemical standards and " Analoid " preparations. Nomenclature now conforms to British Standard 2474: 1954.

DISINFECTANTS and Disinfection

By A. H. Walters, F.I.M.L.T., M.R.S.H., M.I.BIOL.

Silver germicides ● Antibacterial plant extracts ● Antibacterial vapour Swimming pool algicides ● Cinnamic acid derivatives ● Metal chelates Inhibiting sporulation

Silver compounds as soap germicides

Two recent U.S. patents[1] are concerned with silver compounds as soap germicides. One describes a compound as a complex of silver halides with ethylene thiourea, a cyclic compound. While all such compounds are active, it is claimed that the silver chloride complex is outstanding as a soap germicide. This substance was tested at 420 mg. to 200 g. of dry soap and found effectively to reduce skin shed bacteria counts on washing. A recommendation is made that to provide adequate antibacterial activity, a concentration of 500 p.p.m. of silver is required.

The second patent concerns silver benzene sulphinate, a simple organic salt capable of making soap germicidal. Samples of dilute soap solution containing this salt at 100 p.p.m. of silver were inoculated with *B. subtilis*, *Esch. coli* and *S. aureus* and in each case samples became sterile in 5 min. The suggested concentration of silver benzene sulphinate in disinfectant soaps is 500 p.p.m. in silver. The silver salt of α-toluene sulphinic acid also shows some antibacterial activity.

Antibacterial and antimycotic vegetable extracts

The use of medicinal plants and their extracts on open wounds has a very long history. Pouring oil on to a wound to clean it and accelerate healing goes back to antiquity. A German review[2] now reminds us of the antibacterial activity of certain oils (see MANUFACTURING CHEMIST, 1957, **28,** (12), 566). The bactericidal efficacy of eucalyptus, lavender oil and terpinols is confirmed, and some interesting results were obtained from coumarin. The antibacterial action of Tormentill, ratanhia and gall nut tinctures was found to be related to their tannin content. Infusions of the following were found to exert bactericidal action: Cortex Augustoræ, Flor. Coryophylli, Fol. Rubi, Fol. Uvæ ursi, Glandulæ, Lupuli, Herba Euphrasia, Pericarpium Aurantic, Rhiz. Rhei, Rhiz. Tormetillæ. Decoctions of the following were bacteriostatic, Cortex Frangulæ, Cortex Augustoræ, Cortex Chinæ, Cortex Quercus, Flor. Caryophylli, Fl. Ericæ, Fl. Rosæ, Fol. Betulæ, Fol. Eucalypti, Fol. Rosmarini, Fol. Rubi, Fol. Salviæ, Fol. Uvæ ursi, Glandulæ Lupuli, Herba Ephedræ, Lichen Islandicus, Rhiz. Rhei, Rhiz. Tormetillæ, and Semen Arecæ.

Forty per cent. of all plants or drugs tested had spore-bearing bacilli on their surfaces, therefore autoclaved preparations had to be tested. As early as 1926 work in the fungicidal action of some essential oils was reported, among which cinnamon and clove ranked first. Solutions of 0·1% cinnamon oil are said to destroy mycetes in 30 min. and in practice an alcoholic solution of 5% thymol and 2% cinnamon proved satisfactory. Some encouraging results were associated with the use of aqueous solutions of thymol cinnamon and clove oil at 1 : 1000 dilution. Mention is also made of the fungistatic action of garlic and radish extracts.

Beta-propiolactone vapour

Formaldehyde has been used almost exclusively as the gaseous disinfectant of choice for the decontamination of large enclosures contaminated with pathogens. More recently beta-propiolactone (BPL) has been shown to be an effective anti-bacterial and sporocidal substitute. Now work has appeared on the viricidal activity of BPL vapour determining its efficacy against Venezuelan equine encephalomyelitis virus (VEE).[3]

For the sake of convenience the BPL vapour was tested against VEE infected cloth and paper patches. Egg cultures were harvested at peak death period (22-24 hr.), homogenised with cold beef heart infusion broth, centrifuged, ampouled and freeze-dried, as chick embryo seed. Cotton herringbone twill patches $\frac{5}{8}$ in. diameter were infected with 0·2 ml. of chick embryo seed and subsequent treatment with BPL followed immediately while the patches were wet. Squares of filter paper $\frac{1}{2}$ in. square were exposed for 30 min. to a virus aerosol, which caused a relatively dry infection of the paper. The infected cloth patches and paper squares were then subjected to BPL vapour aerolised for 5 min. at 26° at RH 90%. After the aerolisation the patches and squares were left in contact with the vapour for 10 or 25 min.

Results showed that a 15 min. exposure to 2 to 4 mg. of beta-propiolactone per litre of air inactivated 10^8 mouse intraperitoneal LD_{50} of VEE virus per $\frac{5}{8}$ in. diameter surface. It is suggested that BPL might be used as replacement for gaseous formaldehyde for routines decontamination of virus infected areas. It has the advantage of not being persistent, but whether one would care to risk using BPL vapour in the evidence supplied might be open to some question.

Another more searching paper on BPL[4] points out that it raises the problem of skin toxicity, corrosion of metals and denaturation of certain plastics.

Algicides for swimming pools

With the greater use of private swimming pools the problem of preventing algal growth in them increases.

Six commercial compounds, together with copper sulphate, have now been tested in U.S.[5] Three species of algæ were used as test organisms, namely, a green alga, *Chlorella pyrenoidosa*, capable of causing water to appear a pea-soup green; a blue green species of Oscillatoria, isolated from an unsuccessfully treated swimming pool in California, which grows as black balls or mats at the bottom of culture flasks; and a blue green species of Phormidium isolated from a pool in Wisconsin, which grows on the walls of the culture vessel.

The tests were done by inoculating

50 ml. of Allen's (*p*H 7·2) or Fitzgerald's (*p*H 9) medium with approximately $10^6 \times 5$ algal cells, adding the concentration of the chemical to be tested, inoculating at 23° under continuous light (150 ft. candles) and observing growth in treated and untreated flasks over 30 days.

In general it was observed that less chemical was required to kill the algæ tested in the alkaline medium as compared with the neutral medium. The precise composition of the products tested was not available, but the active ingredients of three were Q.A.C.'s, one organic halide, a halogenated quinone, and one, *Algimycin*, was designated a mixture of active ingredients. This mystery product turned out to be the best in relation to recommended initial dosage rates.

This is a rather unfortunate paper coming from a university, because although of undoubted integrity it is written in a diffuse style which blurs it. Also, one really expects to know fairly accurately what compounds are being tested and why certain techniques are adopted.

Antifungal action of cinnamic acid

Cinnamic acid and its derivatives have been reported to have antibacterial, antitubercular and antifungal activity. A total of 27 derivatives based on N - (2 - chlorophenyl) - 2 - chloro - cinnamide, N - (2 - chlorophenyl) - 4 - nitro - cinnamide and N - (4 - chlorophenyl) - 4 - nitrocinnamide have now been made.[6]

Acetone solutions of the compounds were prepared in concentrations of 4, 2, 1 and 0·5%. Saturated solutions were prepared for compounds whose solubility in acetone were less than 0·5%. Sterile filter discs were immersed for 30 sec. in each of the acetone solutions and after draining placed wet on an agar surface previously inoculated with the test organisms. *M. canis*, *M. gypseum*, *T. rubrum* and *T. mentogrophytes* were used. Controls were undecylenic and salicylanilide. After incubation for 15 days at room temperature zones of inhibition of growth greater than 3 mm. in depth were recorded.

Results by these tests indicated that most of the cinnamide derivatives tested had little or no antifungal action *in vitro*. The authors observe that the apparent lack of antifungal action was due to insolubility, and also that the zones of growth inhibition are dependent on the diffusibility of the compounds. Hence *in vitro* results may not correlate with chemical effectiveness.

More on metal chelates

There is still some controversy regarding whether the antibacterial action of chelating agents is due to the agent or the chelate itself. Some work is now reported in which a number of metal chelates of agents having little or no apparent antibacterial activity have been investigated.[7] The authors hoped to find out whether the metal chelate structure, *per se*, is capable of inhibiting growth of micro-organisms. Among the metal chelates tested were some based on antitubercular agents, which are not very active against non-acid-fast vegetative bacteria, in the hope that knowledge might be gained on the importance of chelation in their action against tubercle bacilli.

Altogether a series of 18 metal chelates and complexes of some *a*-amino acids, peptides, isonicotinoyl hydrazide, *p*-aminosalicylic acid, *p* - acetylaminobenzyl thiosemicarbozone, and biotin were screened for antibacterial activity against strains of 10 common laboratory bacteria. The initial method of screening was the agar plate method of the United States Department of Agriculture. The six most promising compounds from this screening were tested quantitatively against *S. aureus* and *E. coli* by a serial tube dilution method, and assessed according to the highest effective dilution.

Results showed the best compounds to be the copper complex and chelate of P.A.S.A., cobalt chelates of I.N.H., and methionine, and copper chelates of glycyl-D.L.-alanine and biotin. In three cases the antibacterial action increased with the partial dissociation of the chelate. In one case the complex was decidedly more active than the metal ion. Whether free metal ion can exist within the living cell or medium in a toxic concentration is still open to question.

Inhibition of sporulation

The mechanism of dormancy and resistance of the bacterial endospore is still a matter for academic discussion. It is known that dipicolinic acid is present in many bacterial spores and absent from the homologous vegetative forms, and this substance may be concerned with spore resistance and dormancy. A study has now been made of the effects of *a*-picolinic acid on the growth and sporulations of *B. cereus* type T. Into a basic liquid medium were incorporated various test compounds, *viz:*

Picolinic acid, nicotinic acid, isonicotinic acid, quinolinic acid, pyridine 2,4 dicarboxylic, pyridine 2,5 dicarboxylic, dipicolinic acid, Versene, *a*-picolinic acid + nicotinic acid, *a*-picolinic acid + dipicolinic acid.

Results indicated that the effect of *a*-picolinic acid could be due to a chelation with some metal essential for sporulation, but not for growth of the substances tested. Only *a*-picolinic acid specifically inhibited sporulation of *B. cereus* without causing permanent injury to the organism. The inhibition can be reversed by zinc, cobalt, nickel, phosphate and yeast extract. This supports the suggestion that *a*-picolinic acid by chelation with an essential metal interferes with an enzymes system necessary from vegetative growth to resting phase.

This extremely interesting paper must be read in full to be appreciated. One rather moot point, perhaps, is that Versene did not effect germination, it did inhibit sporulation and also caused the cells to assume a filamentous growth. This most interesting side observation might be well worth following-up.

REFERENCES

1. "Briefs," Schimmel and Co., 601 W. 26th Street, New York 1, New York.
2. H. Profand, *Perfumery & Es. Oil Rec.*, 1960, **51,** (1), 22.
3. F. W. Dawson, H. J. Hearn and R. K. Hoffmann, *J. App. Bact.*, 1959, **7,** (4), 199.
4. C. E. Feazel and E. W. Lang, *Soap and Chem. Spec.*, 1959, **35,** (10), 113.
5. G. P. Fitzgerald, *App. Microbiol.*, 1959, **7,** (4), 205.
6. H. W. Schultz and G. A. Wiese, *J. Am. Pharm. Ass.*, 1959, **48,** (12), 750.
7. T. C. Counter, R. N. Duvall, W. O. Foye and R. W. Vanderwyk, *J. Am. Pharm. Ass.*, 1960, **49,** (3), 140.
8. K. G. Gollakota and H. O. Halvorson, *J. Bact.*, 1960, **79,** (1), 1.

Fomescol. This is a new surface active agent for the demulsification of fuel oils contaminated with sea water and for cleaning oil tanks. It can be recovered for reuse and this makes it economical. It was developed by the Fuel Research Station, D.S.I.R. and Glovers (Chemicals) Ltd., of Leeds. It is the subject of a handy and informative booklet issued by Glovers and obtainable from them.

FERTILISERS and Plant Nutrients

By D. P. Hopkins, B.SC., F.R.I.C.

Fertiliser consumption in U.K. ● *Garden fertilisers in New England* *Phosphate* ● *Liquid fertilisers* ● *Zinc nutrients*

U.K. farm use

Two statistical - cum - economic reports merit discussion, for current trends in fertiliser use adumbrate future development. The first is a British study of statistics of U.K. fertiliser consumption since the war, mainly in the 1950s.[1] Produced by the industry, this has brought together much data previously available only separately, *e.g.* Board of Trade figures, Ministry of Agriculture figures derived from subsidy claims, and some figures collected by the industry; fertiliser practice survey information has also been utilised in interpreting the collated data. As a result, a clear picture of recent trends in consumption, cropwise and both nationally and regionally, emerges. Consumptions are mainly expressed in terms of plant-food content tonnages.

In the second half of the 1950s, or more precisely from 1952-55 to 1958-59, nitrogen consumption for the whole country has risen by 31·2%, phosphate by 9·5%, potash by 41·8%. In the same period, compound fertilisers have risen in total tonnage by 19·1%, but in terms of plant-food supply by 39·9%. Their share in the national fertiliser nutrient supply per annum has risen from 64·7% to 70·1% (in the case of this comparison only up to 1957-58). The steadily increasing NPK content of compounds is shown as follows: 1952-55, the average total plant-food content was 27·66%, and by 1958-59 it had become 32·48%. Assuming that the same nutrient supply would have been given in 1958-59 without this rise in concentration, then the actual rise represents a saving for farming in the transport and handling of 417,000 tons of material. The nutrient ratio ($N : P_2O_5 : K_2O$) of compounds has changed from 1 : 1.6 : 0·6 in 1945-46 to 1 : 1.3 : 1.6 in 1957-58. However, this last comparison does not entirely reflect technical or consumer-demand influences; there were potash supply problems in 1945-46.

The swing from straights to compounds has had its most marked effect upon superphosphate. In 1945-56 under 33% of the total national use of soluble P_2O_5 was in compound form; this proportion rose to 91% by 1958-59.

The above are all national figures. The breakdowns into crop-group figures or into regional figures probably form the more informative part of the report. Regional changes from 1953-54 to 1957-58 are presented in Table 1.

It is interesting that the two highest proportional rises in fertiliser nutrient use—the Eastern region and Northern Ireland—represent the highest user and the lowest user by rate per acre in 1953-54. The former region's acreage under crops and grass decreased by more than the national average in the period. These two areas exemplify by extremes the two trends now stimulating greater fertiliser use, (*a*) intensifying use on a falling arable acreage, (*b*) increasing rates of use on grass and dressing more of the grassland.

Crop group use is dealt with in the Report by areas, but space here permits only the presentation of national figures for 1957-58, see Table 2.

These data imply that if the average actual rates (those given to acres on farms where fertilisers *are* used) were given to the entire crop group and grass group acreages, the percentage figures for the groups would be transformed. Roots and green crops would receive only 21% and cereals only 17% of total fertiliser nutrient usage; and grassland would receive 62%, as against the 34% of 1957-58. Once again it is clear that the main potential for further expansion of U.K. fertiliser use exists in the country's grassland.

Garden use in New England

The second report is a survey of garden fertiliser use in a six-States region, New England, of the U.S.A.[2] The six States cover 62,000 sq. miles and have a population of 8½ millions, *i.e.* about two-thirds of the U.K. area and one-sixth of U.K. population. The area being north-east of New York, its climate is more comparable with that of the U.K. than, say, the climate of Florida.

Table 1

Area	*Percentage increase in total nutrient use*	*Rates applied per average acre of crops and grass ($N+P_2O_5+K_2O$)*	
		1953-54	*1957-58*
English regions:		*cwt. per acre*	
Eastern	30	0·75	0·97
S. Eastern	27	0·55	0·70
E. Midlands	17	0·62	0·73
S. Western	27	0·41	0·51
W. Midlands	22	0·46	0·57
Yorks. and Lancs.	24	0·50	0·63
Northern	21	0·40	0·48
Wales	24	0·33	0·40
Scotland	19	0·64	0·76
N. Ireland	32	0·32	0·46
United Kingdom	24	0·52	0·64

Table 2

Crop group	*Acreage* %	*N* %	P_2O_5 %	K_2O %	*Total nutrients* %
Roots and green crops	13	34	32	43	36
All cereals	23	31	26	33	30
Temporary grass	20	17	18	13	16
Permanent grass	44	18	24	11	18
All crops and grass	100	100	100	100	100

The survey, conducted by questioning sample numbers of people in 130 districts, revealed these proportions for kinds of garden use: lawns, 57·1%; flowers, 11·4%; vegetables, 26·7%; other uses, 4·8%. The outstanding lawn sector of use has been suspected in comments about British garden fertiliser use.[3] It is presumably the result of a social or psychological desire to maintain good condition for lawns even when less attention is paid to other garden vegetation; also, of course, lawns occupy the largest space in many gardens.

About one in two households used no fertiliser at all, but this ratio for the whole area covered many variations. The more populated the district, the higher the proportion of non-users. Three out of four households in Boston (the city) were non-users; in village or rural areas two out of five were non-users. The quantity of fertiliser used per garden also rises as district population falls, but this must mainly reflect the obvious influence of size of garden.

Only one-eighth of the purchases for garden use were of organic kind, and this included bulky organic materials such as dried manures and sewage products. Seven-eighths were of chemical kind, and compound fertilisers dominated this trade; straight (unmixed) fertilisers accounted for only about 4% of these purchases.

The survey tried to estimate the types of person more likely to be garden fertiliser users, but it is difficult to separate this influence from the associated income influence. Thus, management personnel used the highest average amounts per household—99 lb. of fertiliser per annum—but is this a reflection of outlook or income? Income is likely to be associated not only with ability to buy consumer goods freely but also with size of garden. Professional people and skilled craftsmen used about the same average amount—45-48 lb. per annum. These three types of person were the highest users.

Non-users, except those who were non-users because they had no gardens, were questioned why they did not use fertilisers, and lack of knowledge emerged fairly definitely as the main cause. Reports of poor results or actual damage from other people's misuse of fertilisers were frequently cited. Even among users a poor knowledge of fertiliser choice and use was revealed; a need for sound advice at points of retail sale was exposed.

Even so, the extent of garden fertiliser use shown by this survey is remarkable in terms of any probable British comparison. The garden tonnage in the six States was 53,700 or about 10% of the area's total use including farm consumption! The average consumption per household was 41·5 lb. An attempt has been made to translate these findings into the British background; making large allowances for population difference, likelihood of larger garden space in the less densely populated U.S. area, and for the lower rates of farm use, a figure of 150,000 tons a year for U.K. garden use is arrived at, assuming the existence here of an equivalent demand.[4] It must be doubted whether the total British garden trade approaches this quantity. Yet the New England survey shows plenty of evidence for further expansion.

Phosphate uptake

The effect of irrigation on phosphate uptake by potatoes has been investigated.[5] Superphosphate was applied at five rates from 0 to 2 cwt. of P_2O_5 per acre and half the plots were irrigated during the first three months of growth. Irrigation had the effect of doubling uptake during the first six weeks of growth, and this increase also raised final yields—and at the rate of 1 cwt. of P_2O_5 per acre, this meant that only half as much superphosphate, with irrigation, was required to produce a given response. The principal conclusion of the work seems to be a confirmation of the view that uptake of fertiliser phosphate is higher in wet than in dry seasons.

Another investigation reported[6] has dealt with phosphatic fertilisers for rape and swedes on Northern England soils. Consistent superiority of superphosphate was shown, other fertilisers used being basic slag, a nitro-phosphate, di-calcium phosphate, silico-phosphate and ground rock phosphate. It was indicated that soil temperature influences the release of soil phosphorus in an available form. It was shown that the extra phosphate needed for phosphate-deficient soils in the north is higher than has often been suggested.

Liquid fertilisers

Farm use of liquid nitrogen fertilisers has been investigated and discussed.[7] Liquid ammonia, ammonia liquor, and two aqueous solutions based (*a*) on ammonium nitrate and urea and (*b*) on ammonia and urea were compared—for grass, winter wheat, spring wheat, sugar beet and marrow stem kale—with normal solid fertilisers, sulphate of ammonia and *Nitro-Chalk*. The liquids, for like supplies of nitrogen, gave generally lower dry matter yields with grassland. With the arable crops, efficiencies of liquid and solid sources of N were similar.

Greater problems of application were encountered with the liquid fertilisers, especially in the case of liquid ammonia; damage was done to grass and wheat in running over the land with the necessary injector. It is concluded that liquid fertilisers revealed no advantages, and showed some disadvantages, in these experimental comparisons with solid nitrogen fertilisers. This British conclusion is in some contrast to current U.S. practice, where liquid nitrogen fertilisation is, of course, highly developed. It does not, however, discuss cost per 1% of N.

Some recent U.S. discussions seem relevant.[8] About half the directly applied nitrogen in the U.S.A. was given in a liquid form in 1958, and currently the use of liquid compounds for farm crops is being developed. However, liquid mixtures have not made the same rate of advance as liquid nitrogen fertilisers, not simply because they are newer as an idea but because they are relatively more costly. The costs problem of the liquid compound is created by the need to use phosphoric acid as the phosphate source and by the problem of reaching high enough concentration without risk of potash salts crystallising out of the liquid mix during storage, etc. The use of potassium hydroxide or potassium carbonate is being studied. Liquid compounding plants cost more per 1,000 tons output than solid mixing plants, but the U.S. comparison given—making the cost ratio about 2 : 1—is based upon powder compounds; the ratio may not be nearly as high as 2 : 1 if the basis taken is that of granular compound production. Despite these economic difficulties, there are about 350 liquid mixing plants in the U.S.A. and it is stated that liquid compounds already account for 26% of compound fertiliser use in California.

(*Continued on page* 275)

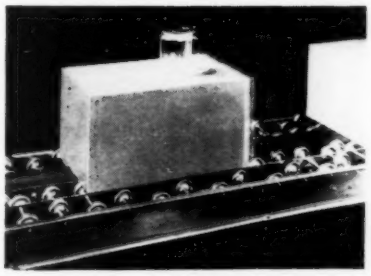
PLANT AND EQUIPMENT

▶CONVEYOR SYSTEM

Positive control of carton line pressures is claimed for the new *Papistan* A.P.C. pressure-sensing conveyor. It accumulates cartons on the line without increasing line pressures: releases accumulated cartons one at a time, automatically spaced for safe and efficient movement: and transports them—all at low power requirements.

The conveyor can solve problems in handling situations involving accumulation and transportation of goods—warehousing, order selection, order assembly and despatch operations.

Maintenance costs are reduced because belt tracking problems are fewer. Belt tension adjustments are seldom required, because spring-operated pressure wheels exert exactly the right amount of belt pressure against the cartons, regardless of belt tension. Since the conveyor operates with negligible line pressures and unusually low power requirements, there is minimum wear on belt or drive mechanisms. The conveyor is made by Manufacturers Equipment Co. Ltd.



Smooth-acting carton conveyor by Manufacturers Equipment Co. The smooth engagement of the power belt with a carton is shown by the glass of water which does not spill during the operation.

▶LIQUEFIED GASES PUMP

In the earlier models of the Distillers Company's pumps for liquefied gases the pumps consisted essentially of a double-acting diaphragm head maintained at low temperature in a refrigerated cell, the diaphragms being actuated by a hydraulic system which allowed the pump to discharge at any rate from maximum to zero without any operating attention to the pump itself. Several of the earliest units produced have operated now for over three years in continuous service with no replacements or maintenance attention. The refrigerating diaphragm cell department in the earlier models was built as a separate part of the pump, the electrical and hydraulic unit being coupled to it.

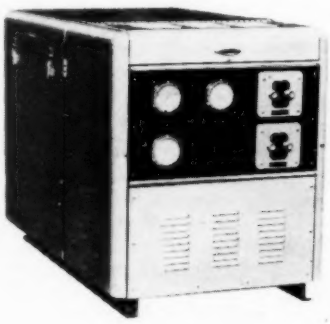
Now a new model has been introduced, of which there will be two standard sizes; one to pump up to 100 gal. an hr. at a pressure of 1,000 p.s.i.; the second of double this capacity. The whole of the diaphragm head unit and hydraulic actuating unit is built into a steel-framed casing finished in grey hammer tone enamel with the control and instrument panel forming an integral part of the unit.

This range of standard pumps is now in production and delivery is offered in two to three months. The refrigerating unit is normally by Frigidaire and supplied as a separate component fitted outside the pump casing, as its capacity and temperature characteristics depend upon the temperature at which the liquefied gas has to be pumped.

The price for a typical pump of 200 gal. an hr. capacity is of the order of £1,650, complete with refrigerator.

▶G.L.C. APPARATUS

The Russian Trade Delegation has placed an order worth £16,000 for 13 gas-liquid chromatographic analysis units with Griffin and George Ltd.



D.C.L. liquefied gases pump.

The order is the result of demonstrations given to the delegation's scientific representatives, at the firm's laboratory and at the Symposium of Micro Chemistry in Birmingham in 1959.

This is the second order from the U.S.S.R. during the last 12 months. The first was for six instruments. These will be largely used in universities.

▶CONTROL OF BOILER SMUTS

Dust Control Processes Ltd. have developed a system to overcome the problem of acidic smut emission from oil-fired and coal-fired boilers.

Smut emission from boilers is primarily caused by the high SO_3 content of the gases and the consequent high dew-point temperature which results in local condensation on cold sections of flues and particularly stacks and the deposition in these sections of very fine greasy particles which build up into loose agglomerates. These agglomerates adhere only very lightly to the flue and stack surfaces so that the slightest variation in gas velocity will entrain them in the gas stream in the form of smuts or sooty flakes. These smuts are of such a size that the majority of them settle within 50 yards or so of the normal stack and the resulting damage can be considerable, not so much because of the black and greasy nature of these deposits, but principally because of their high acid content.

The D.C.P. system of dealing with this problem is to inject into the boiler flue gases, by means of an insufflator, a controlled concentration of a finely divided alkaline hygroscopic precipitate (D.C.P. 58 Sulpho-neutraliser), the particles of which provide nuclei for the absorption of acid and the very fine greasy particles. Some 100 million particles are injected per cubic foot of flue gas and these are subjected to a high degree of turbulence by a turbulator to ensure, in the first stage, the most intimate mixing and contact of the powder and gases and, in the second stage, the maximum agglomeration of the enlarged particles. The agglomerated particles are then extracted from the gas stream by centrifugation in the specially designed Turbocell dust collector. An

important advantage of this system is the neutralising of the acidity of the gases and the entrained particles, which results in the inhibition of corrosion and the reduction of the dew-point temperature of the gases.

The system and equipment are covered by patents.

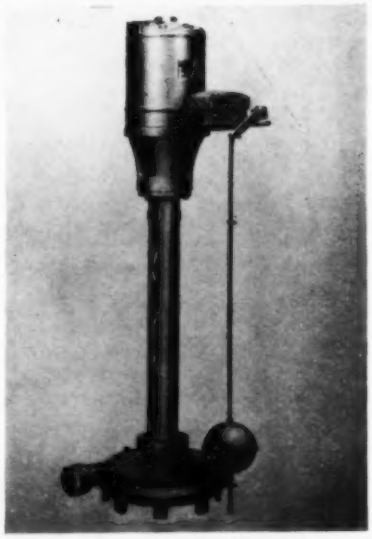
▶SUMP PUMP

Wallwin (Pumps) Ltd. have introduced a small *unchokable* sump pump which, it is claimed, will handle liquor containing solids up to $\frac{7}{8}$ in. diameter, thus obviating choking troubles and avoiding the necessity for the constant cleaning of filters. This new pump is supplied as a fully automatic unit complete with motor, starter and float control gear and can be arranged for operation on either three- or single-phase supply.

The unit is simple in design, and fitted with self-lubricating bearings, mechanical seal and a single-bladed open type unchokable impeller. It can be supplied built from special materials to suit customers' requirements. The price is £49 10s. (approx).

▶FULLY AUTOMATIC PACKAGING

At the German Interpack exhibition a fully automatic filling and packaging plant for tablets and dragees was demonstrated, handling Bayer products. The plant is made by Hofliger and Karg, whose machinery is sold in the U.K. by Baker Perkins and the Forgrove Machinery Co. Ltd. The plant consists of a VTA III/DAS tablet and dragee filling and closing machine linked to a labelling machine connected in turn to a CAR IIIa cartoning machine. It deals with a glass bottle every second. The VTA III section of the unit is for tablets, the DAS for dragees. The two units cannot be operated simultaneously. The VTA III is designed to count out a number of round tablets, and to fill them automatically into tubes or bottles. When filling tubes, the tablets are loaded in orderly fashion, one on top of the other; with bottles, they assume random order. The machine will fill up to a maximum of about 100 tablets per operation and can deal with diameters from $\frac{1}{4}$ in. to $\frac{33}{32}$ in. Tubes or bottles are fed into the pockets of an intermittent chain infeed. Tablet feed can be by two internal vibrating feeders leading to a number of storage columns or from a single hopper to a vibratory chute leading to a rotating disc



This sump pump is claimed to be able to handle liquor containing solids up to $\frac{7}{8}$ in. dia.

which feeds the storage columns.

The DAS unit is used to count pills, capsules and similar products into bottles or tubes.

The pills are oscillated by a vertical plunger as they lie in the feed hopper, and are tilted into a number of hollow feeding tubes. The plunger keeps the feeding tubes filled with pills (providing the feed hopper itself is kept charged). The bottom pills fall into a brass plate which is cut to receive one or two pills, and this moves horizontally in conjunction with another slide. The 20 feeding tubes are mounted over two hoppers and the bottles or tubes are normally filled in two stages. In this way and by changing the brass plate, a count is made of practically any number up to 40 and is delivered to the bottle or tube. The bottles or tubes can be hopper fed into the pocket chain infeed of the machine.

Finally the VTA III/DAS combination will close the glass bottles by capping.

After labelling, a CAR 3a fully-automatic cartoning machine completes the operation. This unit is designed to take from the flat a preglued, open-ended carton, form it, load and close.

Another exhibit was a GKF-IV gelatine capsule powder filling and closing machine. Running at a speed of up to 150 per min., this unit opens the capsule, feeds and closes it. The capsules are fed in bulk into a hopper from which they pass down tubes to a sorting device which ensures that each one is fed and dropped into a horizontal carrier with the "top" uppermost. A second carrier passses under the first and suction is used to carry the bottom half away from the top, which is retained by the first carrier. The bottom half is filled with precisely the correct amount of powder (not to its capacity), represented under its top and the two then pressed together.

▶COOLING TOWER

A completely new type of cooling tower, weighing less than half as much as conventional towers of similar capacity, has been introduced by Thermotank Ltd. The saving in weight, and in size, is achieved by the use of a plastic-cellulose fill material in which the water is cooled by a counter-current of air as it passes through very closely-spaced elements.

The tower, which is circular in shape, contains a top-mounted fan which draws the surrounding air up through it from the bottom. The fill, which resembles a honeycomb in its structure, is arranged across the inside of the tower with the channels disposed vertically, and the cooling air passes up through these channels. Water enters the tower at the top, and is distributed across the surface of the fill by a centrally-mounted rotating header pipe containing a number of perforations along its length through which the water streams on to the fill. The perforations vary in size along the length of the header to ensure an even distribution of water.

The material of the fill has a high wettability, and the water passes down the walls of the channels in a thin, continuously-moving film. This ensures the maximum area of contact between the rising currents of air and the water, thus utilising the volume of fill to its greatest capacity. A catchment tray at the base of the tower collects the cooled water for return to the appliance in which it is required.

The structure is fabricated from rolled steel sections, treated against corrosion.

Initially these Thermotank cooling towers are being made in 12 graduated sizes, the largest of which can deal with up to 90,000 gal. of water an hour; yet it has a diameter of only 20 ft., a height of 12 ft., and a total weight of 9½ tons. Conventional towers of such capacity are generally much heavier and considerably larger.

BOOK REVIEWS

Textbook of Pharmaceutical Chemistry

Revised by J. E. Driver. Pp. 728. *Oxford University Press*, 63*s. net.*

IT IS often the fate of comprehensive textbooks to be judged not by their achievements but by their degree of failure. The magnitude of the task is considered to preclude success, and a degree of failure is regarded as inevitable. But books, like men, must be judged for what they are, and not for what they might be, and in pharmaceutical literature Driver's textbook has long had an unchallenged place.

Originally published in 1925 under the joint authorship of A. O. Bentley and J. E. Driver, it has been continually revised by the latter, and this edition is the seventh of a distinguished series. The subject of pharmaceutical chemistry was extensive in 1925, and has since grown enormously, as its ramifications extend with every advance in therapeutics. This edition of the book has been almost rewritten in the light of such advances, and fully maintains its high reputation.

Part I deals with the chemical and physical methods used in testing the purity of drugs, and Part II is concerned with inorganic chemistry generally, with particular reference to substances described in the B.P. The older pharmacist, whose ideas on nuclear structure, radioactivity and valency are more imprecise than clear, will find useful guidance on these subjects in this section. The notes on resonance, although brief, shed valuable light on a subject which some find difficult.

In Part III organic compounds of pharmaceutical interest are discussed against a general background of the subject, and here a considerable amount of information is given, as for example the chemistry of various tests and assays, that is not always readily accessible to students. At the same time, this section has the defects of its qualities. Illustrations of certain simple apparatus take up valuable space, and elsewhere graphic formulæ are repeated in rapid succession to an unnecessary degree. The references to original literature are useful, but some are not as recent as could be wished. Under insulin, for example, a reference is made to a summary of its chemistry by Sanger in 1948, whereas neither in the text nor in the footnotes is any mention made of his brilliant work in elucidating the complete structure of insulin, which was announced in 1955. A brief reference to this outstanding research would have been valuable.

In general, however, the book is remarkable for its achievement in giving a balanced account of a very wide subject. The style is clear and very readable, and whilst the book is essential for the student, it will continue to be valuable long after qualification has been obtained.

S. J. HOPKINS.

Organic Syntheses

Vols. 38 *and* 39. *Wiley, New York; Chapman and Hall, London. Pp.* 120 *and pp.* 114. 32*s. each net.*

"ORGANIC SYNTHESES" appears regularly as a means of publishing independent work. It is the result of the combined efforts of the editorial and advisory boards, whose members have actively participated, acting as checkers together with at least one other independent worker.

Volume 38 contains 31 preparations, the results of 53 chemists, working in 26 teams. Four of these contributions are from foreign research centres, and while most of the work reported has been carried out in academic institutions, a few have been received from industrial laboratories. The compounds described are not uncommon and are likely to be met in Universities and in industrial laboratories as useful intermediates, *e.g.* vinyl acetylene, methyl malonic ester, diphenyl acetaldehyde, stilbene oxide. Each synthesis includes details of the laboratory scale preparation, the apparatus described being uncomplicated. Special precautionary notes are included to give the best yields and highest purity and physical properties such as melting- or boiling-point, refractive index, density are recorded. In addition, references are given to methods of preparation already published. Of interest is the low temperature distillation described on p. 70. 168 references.

Vol. 39 contains 28 preparations and again a few have been submitted by non-American authors. But the majority come from the big academic institutions like the Massachusetts Institute of Technology and from large firms like du Pont. Following the style of these volumes the preparations appear in alphabetical order of common names of the compounds. Among those in vol. 39 are benzeneboronic anhydride, di-*n*-butyldivinyltin, *p*-dithiane, 9-methylfluorene, tetraacetylethane, triptycene and trithiocarbodiglycolic acid.

Teachers and students should find this series particularly useful for techniques in organic chemistry.

LEON RAPHAEL.

BOOKSHOP SERVICE

Technical Books
308 Euston Road
London, NW 1
Telephone Euston 5911

as retail booksellers will be pleased to supply any books reviewed in *Manufacturing Chemist* and will give immediate attention to any requirements you may have for other works.

Reports on the Progress of Applied Chemistry

Vol. XLIII. Edited by H. S. Rooke. Society of Chemical Industry, London, 1958. *Pp.* 911. 100*s. net.*

THESE reports published annually by the S.C.I., can serve as a useful geiger counter to measure the rate of activity in practically every sphere of industrial and applied chemistry.

The 1958 edition is divided into eight chapters, which are subdivided into 41 smaller sections. The chapters deal with fuel and fuel products, organic chemistry, inorganic chemistry, metals, biological products, textiles, plastics, paints, chemical engineering and hazards (an unfortunate heading), agriculture and food.

These are the same chapters as in the 1957 edition. Interesting additions and omissions have, however, been made in the sections. Two new sections dealing with explosives and cosmetic and toilet preparations have been added to organic chemistry, whereas a new section on essential

oils has been grouped into the agriculture and food chapter. This might surprise Ruszicka and Naves, who have all their lives considered themselves as organic chemists. Both the sections on industrial gases and industrial uses of radioisotopes have been omitted altogether. This is surprising and unjustified.

The space allotted to the various sections is rather odd at first sight. Whereas 38 pages have been devoted to plastics and nine pages to rubber, only 13 pages have been allotted to basic chemical engineering which includes fluid-flow heat transfer and unit operations. It would seem to be nearly impossible to review over 2,000 chemical engineering papers in such a short space, yet it has been done.

An interesting use of radioactive tracers has been described in which the tracer is injected into the flow stream and the radiation measured with a geiger counter. This technique has been applied both to measure large water flows in heat exchangers and entrainment in distillation columns. It has been pointed out that the main difficulty encountered in the analysis of mass transfer processes (absorption, distillation and extraction) is the lack of published data. Although reliable experimental values of physical quantities are more useful than predicted ones, considerable reliance has been made in design work on estimated quantities.

Very little work, as usual, has been done on mixing. This operation is still unfashionable in scientific circles and one wonders when the industry will wake up to its importance and to the time and money that could be saved if mixers were designed from fundamental principles.

This volume altogether is packed with useful information. It is probably one of the most useful reference books revised annually and should adorn the shelf of every chemist and chemical engineer.

I. L. HEPNER.

WRITING A BOOK?

The publishers of MANUFACTURING CHEMIST invite the submission of manuscripts of books to be considered for publication. All manuscripts will be promptly acknowledged and carefully considered by qualified experts. A synopsis with chapter headings should be sent in the first instance to The Manager, Leonard Hill (Books) Ltd., Leonard Hill House, Eden Street, London, N.W.1. Leonard Hill are specialists in industrial, technical and scientific books. They have a reputation for vigorous and successful promotion of their books by extensive advertising and maintain a world wide selling and distributing organisation.

THE SKF LABORATORIES

(*Continued from page* 249)

methods to 20 litre scale for subsequent transfer to the Tonbridge factory. This department also prepares drugs for clinical trial.

The importance of sustained release products is such that one section is devoted entirely to their routine examination. Individual pellet groups and the final blends are subjected to intensive *in vitro* examination to specifications based upon *in vivo* observations. Special attention is given to the uniformity of each capsule fill and its composition.

Another section tests all tablet formulations both plain and coated. Appropriate procedures are used to provide data on drug content, physical characteristics and drug release.

All raw materials—drugs and containers—used in SKF products and in the chemical plant at Tonbridge are examined in another section of the laboratories. Samples are tested against stringent specifications with particular regard to purity and contamination.

Among the many instruments used in the research and development area are infra-red and ultra-violet spectrophotometers. A special section is devoted to spectrophotometric research. Other sections are concerned with the development of analytical chemicals for new drugs and formulations and, finally, there is a microchemistry section. The new building includes the SKF Research Institute under Professor W. A. Bain. This is directly responsible to the parent company in the U.S.

Although the new premises at Welwyn were completed only a few months ago, extensions are already under way. The building is located on the edge of the industrial area at Welwyn and the factory site extends for more than nine acres. Five hundred people are employed at present and with associated manufacturing and selling companies in Sydney, Australia and Johannesburg, South Africa, the total of employees is 750. The managing director is Mr. Richard Pfizenmaier.

FLOW MEASUREMENT

(*Continued from page* 248)

conjunction with pilot valves are used. The desired value would be set in terms of air pressure and, in this instance, the difference between this air pressure and that representing the actual value of the rate of flow is applied across the diaphragm, the minute deflection of which, via the pilot valve, alters the output air pressure, which pressure, again, is fed back into the controlling unit to re-balance the diaphragm mechanism.

To facilitate maintenance, plug-in controlling units are used and the same type of connections may be used for the components of the miniature receiver recorders.

It may be pointed out here that the transducers mentioned earlier in this article have essentially the same characteristics as the corresponding forms of controlling units with a proportional-only action. Also, that the controlling units described may be used for the automatic control of any physical variable, providing the value of this can be expressed in terms of a 3 to 15 p.s.i. air pressure.

In the last few years a number of electronic controlling units have appeared on the market and are available with the same combination of control actions as those of the pneumatic form. When these are used, transducers are required to express the value of the measured variable in terms of an electrical quantity—say 5 to 15 milliamps. For flow measurement by differential pressure means, transducers are available which give an electrical output directly proportional to rate of flow, instead of directly proportional to differential pressure. However, satisfactory forms of electrically operated regulating units have not yet been developed and it is still necessary, in most cases, to convert the electrical output from the controller into a 3 to 15 p.s.i. air signal.

Advanced forms of these controlling units employ transistors and printed circuits.

A New Law to Control Cosmetics?

A CHANGE in the law in order to control the sale of cosmetics would be considered by the Government if it were shown to be needed to avoid risk to health. But on present evidence, the Minister of Health, Mr. Derek Walker-Smith, is not convinced that such a need exists.

This was the Ministerial answer last month (May) when a woman M.P.—Mrs. Joyce Butler (Labour, Wood Green)—raised the possibility of amending the existing legislation for this purpose. She said that various skin troubles and other difficulties followed the use of unsatisfactory cosmetics, and that the Institute of Weights and Measures Administration, whose members had an unrivalled knowledge of consumer protection, had recommended control in this country similar to that in the United States and Canada. In view of this, asked Mrs. Butler, would the Minister study the evidence available with a view to bringing in amending legislation at an early date if the evidence showed it to be necessary?

Mr. Walker-Smith assured her he was willing to pursue any further studies into this or any other evidence which might be available. But he would have to be satisfied on health grounds that a genuine need existed before imposing this control.

He was asked by Dr. Edith Summerskill (Labour, Warrington) whether his scientific advisers rejected the view held by scientists in America that certain lipsticks had carcinogenic properties.

Replied Mr. Walker-Smith: "I am advised that, in fact, the general medical view is that when used as an external application in very small doses these things have little, if any, injurious effects."

Drugs for private patients

There were no fresh developments late last month about the move to provide drugs under the Health Service for private patients.

When Mr. Marcus Lipton (Labour, Brixton) asked the Health Minister whether he proposed to bring in legislation to enable this to be done, Mr. Walker-Smith said he had nothing to add to his previous replies on the subject. Mr. Lipton expressed the hope that he would continue to "resist the misguided efforts" of a number of Conservative M.P.s to introduce the change.

Salk vaccine prices

Which United States firms with subsidiary companies in Great Britain were being charged before the Senate Anti-Monopoly Sub-Committee with having created public hardship by the monopolist control of prices for Salk vaccine, asked Mr. Maurice Edelman (Labour, Coventry, N.). He further asked what enquiry the Minister of Health had made into the incidence of comparable practices by these firms in this country.

Mr. Walker-Smith said that, so far as he was aware, no charges relating specifically to the price of Salk vaccine had been made before the Senate Sub-Committee on Anti-Trust and Monopoly. Five manufacturers of Salk vaccine were recently charged with price fixing by the Federal Government in the courts but he understood the charge was dismissed.

Ethanediol imports

United Kingdom manufacturers of ethanediol had applied for the imposition of an anti-dumping duty on imports of this material from the United States on the grounds that it was being sold here at dumped prices and that this was causing them material injury, reported Mr. John Rodgers, Parliamentary Secretary, Board of Trade. Those interested had been given an opportunity, in accordance with normal practice, of submitting comments to the B.o.T. in confidence, and these were being examined.

A case of cost-plus

Mr. Reginald Maudling, President of the Board of Trade, was asked by a Labour M.P. to refer to the Monopolies Commission the terms and conditions under which a chemical required by the Atomic Energy Authority was supplied by the sole manufacturers. Mr. William Warbey (Ashfield) referred to evidence about this in the report of the Comptroller and Auditor General. The M.P. said the manufacturers refused to supply the chemical except on a cost-plus basis and insisted upon a minimum profit of 17%, rising to 45%, and insisted in addition that the cost should include the amortisation of the capital expended on new plant over a period of five years.

Mr. Maudling said that evidence on the matter was being given before the Public Accounts Committee and when the Committee's report was available he would consider whether any action on his part was appropriate.

Fertiliser price raised

Exporters in both countries had undertaken to increase their export prices to the U.K. by £2 10s. per ton, it was stated when Mr. Maudling was asked by what amounts the Belgian and German manufacturers of sulphate of ammonia had agreed to raise prices following consideration of an application for an anti-dumping duty.

Mr. Maudling said that he had studied the case with great care and there was a clearly established margin of dumping here. The additional increase in price which had been accepted was based upon the dumping margin which had been established.

Dangerous loads

The Home Office was co-operating with the chemical and transport industries in preparing a scheme for the marking of vehicles carrying dangerous substances, Mr. Dennis Vosper, Home Office Joint Under-Secretary, informed a Member who expressed concern about the large quantities of dangerous acids, oils and other materials being conveyed in road transport tanks. Mr. Vosper added that the question whether additional safety requirements were needed was kept constantly under review.

Packaging

Collapsible crate

A collapsible intermediate size bulk container for chemical powders, flakes etc.,—the *Bowmic*—has been introduced by the Dyestuffs Division of I.C.I.

This container which is constructed of Weldmesh Ref. No. 35 (3 in. by 3 in. mesh 5 swg) is capable of carrying ½ to ¾ ton of material in a large two-ply paper liner. It is relatively cheap in cost, collapsible for return empty and can be handled conveniently by pallet or fork truck.

Hitherto, emptying has been the greatest difficulty with this type of container and to overcome this a unique type of sliding closure in the base has been designed which allows the contents to be dropped easily in the quantities required.

The Weldmesh is supplied by the sole manufacturers, The B.R.C. Engineering Co.

The photographs illustrate the container now in use for free flowing products and work is proceeding on the development of a suitable design of container for use with products of a less free flowing nature.

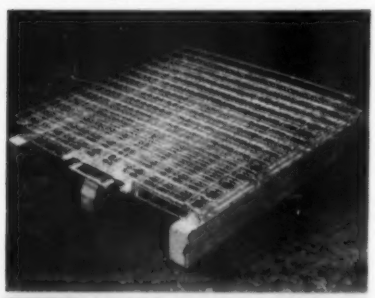
Pack bundling with pressure-sensitive tapes

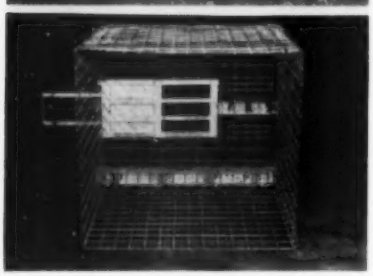
Whether the operation is the attaching of a free gift to a pack or that of making two or more packs of a product into a composite unit to form a " special offer " pack, choosing the right assembly method is very important. At first sight, irregular-shaped items may even appear to be impossible to bind together.

Obviously, it is vital that the resulting composite pack be strong enough to withstand the stresses and strains of bulk packing and retail display, in the latter case particularly where " tumbled " display is employed.

Another hazard for the manufacturer marketing a premium pack arises if the individual cans or packs are separated, thus destroying the whole object of the promotion scheme. In this event the removal of the self-adhesive bands leaves tell-tale tear marks on the labels to which they are affixed.

A " special offer " pack needs some kind of announcement on the unit itself.





Top: **Bowmic collapsed.** *Bottom:* **Empty Bowmic crate showing base slide.**

A tin bundling machine solves premium pack problem. Two bands of printed " Sellotape," automatically applied, join three tins of " Red Heart " dog food to make a composite unit.

This would appear to indicate special printing or labelling. Dual-purpose printed Sellotape bands, however, not only fix the packs in position, they also announce the offer. Thus the cost of specially printed labels can be saved.

The operation may be manual, semi- or fully automatic. Information on bundling methods and taping machinery to meet every production line requirement is obtainable through the Sellomation Service, 8-10 Paul Street, London, E.C.2.

Non-stick paper sacks

A new paper sack has been produced by William Palfrey Ltd., London, E.C.1, in which the inside ply is silicone-treated to give a non-stick surface. This development removes the former difficulties encountered by some manufacturers who found that the innermost ply of the sack adhered to sticky contents. *Palfsacks* can now be used satisfactorily for the bagging of substances of even the tackiest nature, it is claimed.

Asphalt, glue, bitumen, products with a resin base, rubber compounds and so on, can be packaged in the sacks which have received the silicone treatment.

The type of talcum powder container which the Ghana Chemical Industries Ltd. Pioneer Plant will produce. For comparison a normal standard size talcum powder tin is also shown.

The sack can be easily stripped off when required, the innermost ply coming readily away from the contents and leaving no kraft paper adhering to them when they are melted down for further use. Palfsacks treated with silicone possess a further useful quality in that they offer a high degree of water repellency.

This new construction enables the Palfsacks to be used for products which have to be run into the bags in hot form. When this is done the Palfsacks are sometimes placed into formers to ensure an even spread of the molten material during its cooling period. In this way the original cylindrical shape can be retained for many materials, this shape being preferred because of the ease of handling it affords.

Packs for Ghana

A pioneer plant for the manufacture and assembly of a variety of shapes and sizes of talcum and other tin-plate containers is being established as a self-contained unit of Ghana Chemical Industries Ltd. of P.O. Box 489, Takoradi, Ghana, and like other new industrial developments in the country has the interest of the Government.

Dr. S. J. Baker, of the Baker Research Laboratories Ltd., of 8, Harley Street, London, W.1, is the technical advisor to the company and is responsible for the overall plant and chemical installation and for the technical training of the Ghanaian personnel.

The John Dale Group through Mr. J. C. Brockbank— consultant on tinplate stampings—is responsible for advising on the supply of production equipment for the metal containers. Body forming, angle bending, grooving, pressing and seaming plant is in course of erection at Takoradi.

John Dale Ltd. will supply printed body blanks and certain other components such as plastic caps from their New Southgate, London, N.11, factory for making up into complete containers.

NEWS . . .

Guarding workers against toxic fumes

Measures for the protection of workers against the inhalation of dusts or fumes or other impurities likely to be injurious are discussed in a new booklet, "Toxic Substances in Factory Atmospheres,"* published by the Ministry of Labour.

"It is of prime importance," the booklet states, "always to be on the lookout for a possible hazard, and to bear in mind the possible need for precautions." A toxic substance should wherever possible be substituted by a harmless one or, failing this, a less harmful substance. Where a toxic substance must be used, and substitution is impossible or only partially possible, the best protection lies in the total enclosure of the process or plant, or failing this, the use of the "fume cupboard" principle familiar in chemical laboratories. "Built in" safety precautions are always preferable to personal protective equipment, but in cases in which toxic dusts or fumes cannot be adequately controlled by any of the methods discussed in the booklet, appropriate respirators or breathing apparatus should be provided and worn. The need to wear protective clothing and for thorough washing of exposed parts of the body is emphasised as means of protection against toxic materials which can be absorbed through the skin.

The booklet gives figures of maximum permissible concentrations of certain substances used in industry as a guide to which the efficiency of control measures should be related. These figures are subject to revision in the light of increasing scientific knowledge.

Amendments to the list will be published from time to time and arrangements have been made to send them on request to those who return a postcard in the booklet indicating their desire to have the alterations.

* Safety Health aud Welfare Booklets, New Series No. 8, H.M. Stationery Office, price 1s. net.

Guenther speaks on essential oils

There was a "full house" for two lectures on essential oils by Dr. Ernest Guenther at the Royal Commonwealth Society in London on May 4. The lectures were arranged by the British Aromatic Compound Manufacturers' Association, who had invited the renowned expert to repeat a visit he made to this country about two years ago.

Dr. Guenther's first lecture, illustrated with coloured slides, ranged from citrus oil in Florida to ylang ylang in the island of Nossi Be. Dealing first with citrus oils, Dr. Guenther discussed production in Sicily and pointed out that the old method of hand pressing, which gives an excellent oil, is still practised on a small scale. He then made a comparison by describing and illustrating the Florida and Californian citrus industries. Continuing in the U.S., he described the gathering and distillation of wintergreen and the production of oil of sweet birch in New York State. He concluded his section on the U.S. with references to peppermint in Oregon and Washington States and to dill and spearmint.

He next dealt with citronella and lemongrass production in Guatemala and pointed out that at one time production was as much as 750,000 lb. of citronella and 500,000 lb. of lemongrass. This was now down to 230,000 lb. and 200,000 lb. respectively, partly owing to the high cost of production as compared with the Far East.

Dr. Guenther continued by describing geranium oil production in Réunion island. He pointed out that this was a very primitive industry carried on by sharecroppers at a very low level of existence. The yield was never more than about 1·75 lb. of oil per 100 lb. of plant material; the total production was in the region of 75,000 kg. p.a. He concluded with a description of vetivert oil production in Réunion.

The second lecture consisted of Dr. Guenther's colour film with sound track on South American essential oils. This excellent film concluded a most enjoyable and entertaining visit.

The day before he gave his lectures, Dr. Guenther was entertained to lunch by the BACMA at the Guildhall, London, where he was introduced by the chairman of the Association, Mr. J. A. Clark.

Chemistry at the B.A. meeting

The annual meeting of the British Association will be held in Cardiff from August 31 to September 7. The president, Sir George Thomson, F.R.S., will deliver an address called "The Two Aspects of Science."

President of the chemistry section is Dr. James Taylor. His presidential address will be called "Chemistry is not Enough."

On September 5 Dr. E. B. Chain, F.R.S., will deliver an evening discourse on "Microbiological Methods in the Development of Drugs."

Newton Chambers buy Ronuk

Newton Chambers and Co. Ltd. of Thorncliffe, Sheffield, has bought Ronuk Ltd., polish manufacturers, founded 64 years ago in Brighton.

Newton Chambers, established in 1793, have an authorised capital of £3 million. As well as the chemicals division in which the well-known range of *Izal* products is made and marketed, they also have engineering and excavator divisions at Thorncliffe. In April 1958 they acquired Ransomes and Rapier Ltd. of Ipswich.

Although the Ronuk company will be under new control the famous name will continue. The factory at Portslade will be maintained and Ronuk products will still be sold all over the world.

Board changes at Spencer Chapman & Messel

Spencer Chapman and Messel Ltd. and its subsidiary, Theodore St. Just and Co. Ltd., have made changes in their boards following the acquisition of Spencer Chapman and Messel by Borax (Holdings) Ltd. and F. W. Berk and Co. Ltd.

N. J. Travis, T. A. Mason, N. C. Pearson, F. A. Rivett, C. H. Tanner and J. D. Tennant have been appointed directors of Spencer Chapman and Messel. H. Heathcote has resigned from the board and from the chairmanship. Mr. Travis has been elected chairman and Mr. Mason has been appointed joint managing director with Mrs. E. Heathcote. S. F. G. Bird continues as sales director.

New appointments to the board of Theodore St. Just are N. J. Travis (chairman), R. J. Assheton, R. E. Berk, W. G. Loos, N. C. Pearson, C. H. Tanner and J. D. Tennant. H. Heathcote, Mrs. E. Heathcote and S. F. G. Bird have resigned from the board, Dr. H. R. Soper continues as managing director.

Study group on toxic chemicals

The Research Study Group, which was appointed by the Minister of Agriculture to study the need for further research into the effects of the use of toxic chemicals in agriculture and food storage, has begun its enquiries. The Group is prepared to receive written evidence of views on the subject of the inquiry from persons or organisations. It should be addressed to the Secretary of the Group, Dr. E. J. Miller, Plant Pathology Laboratory, Hatching Green, Harpenden, Herts.

B.D.H.'s Irish company

A new company to be known as B.D.H. (Ireland) Ltd. is to be formed to undertake the manufacture and distribution of B.D.H. products in the Republic of Ireland. It is expected that the company will commence trading by the end of 1960. Mr. W. P. Mullen, who has represented B.D.H. in Eire since 1943, will become director and general manager.

Great success of symposium on distillation

The increasing importance of distillation as a unit operation in the chemical industry was stressed by Sir Alexander Fleck when he presented the opening address at the International Symposium on Distillation which was held in Brighton from May 4-6.

To give some idea of the rate of growth of distillation, Sir Alexander mentioned that in 1935 at I.C.I. the distillation load was estimated at 295,000 tons p.a. Soon after the war this had increased to 667,000 tons and by 1959 this had further increased to 2·6 million tons p.a.

The interest in this subject was demonstrated by the large number of delegates (600) who came from every part of the world. Among those taking a leading part in the symposium were Prof. E. Kirschbaum (Germany), Dr. A. J. V. Underwood (U.K.), and Prof. W. K. Lewis (U.S.A.), who can probably be considered as the pioneers of chemical engineering. The subject-matter presented ranged from theoretical considerations of mass and heat transfer and vapour-liquid equilibria to practical design data for commercial columns and studies of plate efficiencies.

The symposium was arranged as the 24th meeting of the European Federation of Chemical Engineering. The Association of British Chemical Manufacturers and the British Chemical Plant Manufacturers' Association had set up a joint panel to examine all aspects of distillation and to indicate the lines which future research should follow. The two associations then suggested to the Institution of Chemical Engineers that the time was ripe for a symposium on the subject. This suggestion was welcomed by the Institution and a joint organising committee was set up under the chairmanship of Mr. C. S. Windebank, M.I.CHEM.E., which included representatives of the Institution and a representative of the Chemical Engineering Group. From the papers offered, the organising committee, on the advice of the referees and in consultation with the chairman of the Institution's Publication Committee (Dr. R. Edgeworth Johnstone, M.I.CHEM.E.), selected 28 papers from authors in 10 countries. Pre-prints of these papers were in the hands of those registering for the symposium well in advance of the meeting. This enabled the authors to present their papers in brief and thus allow time for a comprehensive discussion.

A feature of the symposium was the simultaneous translation service into English, French and German, which was installed at a cost of several hundred pounds. This gave the meeting a truly international atmosphere, reminiscent of the United Nations. In spite of this service most German authors preferred to speak in English; whereas the Russian authors were hampered by language difficulties due to the absence of a Russian translator.

Altogether this symposium was a remarkably successful achievement and both the Institution of Chemical Engineers and all others associated with the organisation of this event are to be congratulated.

Flowers and their fragrance

The well-known perfumer E. S. Maurer presented a paper on "Fragrance in the Natural Orders" at a meeting of the Society of Cosmetic Chemists of Great Britain in London recently.

He outlined the historical development of herbal knowledge from Biblical times and emphasised the initial interest in the foliage of the plant rather than the flower. Floral gardens which we now accept as a normal feature of life were in the middle ages greatly lacking in variety and much of the botanical knowledge of the times lay in the herbal gardens of the monasteries. It was not until the late eighteenth century that serious interest was shown in the flowers and their fragrance.

The lecturer concluded by commenting on the various odours found in different species of the more common families of plants, many of which were of direct interest to perfumers.

Throughout his lecture Mr. Maurer made frequent reference to the appropriate herbals and books relevant to the subject. A bibliography will be included when the paper is published in the Journal of the Society.

The meeting closed with a vote of thanks proposed by Dr. R. H. Marriott, who also congratulated Mr. Maurer upon his award of the Honorary Membership of the American Society of Perfumers, in recognition of his services to the industry.

"Miss Pears 1960"

D. and W. Gibbs Ltd. arranged a delightful river trip on the Thames to Greenwich on the occasion of the final judging of their "Miss Pears 1960" competition. The "prettiest little girl in the United Kingdom," Suzanne Lowndes of Carmarthen, was presented with a cheque for £500 by Anne Thelwell, "Miss United Kingdom," aboard the M.V. *Queen Elizabeth*, moored at the Festival Hall Pier. Suzanne's picture will be appearing in advertisements for Pears transparent soap throughout 1960.

Company finance

British Drug Houses. Group net profit increased during 1959 to £326,688 (£288,991). Dividend 24% (12%).

British Impulse Proteins Ltd.

British Impulse Proteins Ltd. has been incorporated with a share capital of £250,000 in ordinary shares, the shareholders being British Glues and Chemicals Ltd. and Agricultural Holdings Co. Ltd. (the holding company for the Gunson Group of Companies).

The directors are: I. H. Chayen (chairman), G. Balint, L. J. H. Dark (also secretary), R. Guttmann, A. Hawkyard, J. Macaskill.

The registered office is: 20/21 St. Dunstan's Hill, London, E.C.3.

The new company has acquired a U.K. licence to operate the Chayen Impulse Protein Process for the extraction from vegetable materials of protein isolate and other derivatives (see M.C. October 1959, p. 389). The company will also market these products.

Cosmetic symposium

A Scientific Symposium of the Society of Cosmetic Chemists of Great Britain will be held on August 25. A cocktail party will be held on the evening of August 24 at the Royal Society of Arts, John Adam Street, London, W.C.2, to welcome overseas guests. The following lectures have been arranged: Preservation of emulsions, by H. W. Hibbott; Surface chemical techniques in the design of cosmetic preparations, by A. M. Posner; Techniques of foam measurement, by G. Neu; and Musk, by J. Pickthall.

Royal Society tercentenary celebrations

The Queen and the Duke of Edinburgh will take part in the Tercentenary Celebrations of the Royal Society which are planned for the period July 18-26, 1960.

Her Majesty, who is Patron of the Royal Society, will open the celebrations at the formal opening ceremony in the Royal Albert Hall on the afternoon of Tuesday, July 19. The Queen will be accompanied by the Duke of Edinburgh, a Fellow of the Society since 1951.

Immediately before Her Majesty's address there will be a processional entry, in academic robes, of all those taking formal part in the ceremony—Fellows and Foreign Members of the Royal Society, and about 250 eminent scientists from some 50 countries who have been invited to London to participate in the celebrations.

For this occasion Sir Arthur Bliss, Master of the Queen's Musick, has composed a "Salute to the Royal Society," to be played by Dr. G. Thalben-Ball on the organ, and the band and trumpeters of the Royal Military College of Music.

Sir Cyril Hinshelwood, the Society's President, will deliver the Tercentenary Address.

There will be a number of short speeches and the presentation of congratulatory addresses by selected representatives of United Kingdom and oversea organisations.

People

The Board of Croda Ltd. announce that **F. A. S. Wood** has been elected chairman to succeed the late **Sir Edward Crowe.** Mr. Wood remains managing director of the company. The board also elected **Norman Townend**, F.C.A., a director of the company.

N. A. Iliff is the new managing director of Shell Chemical Co. Ltd. He succeeds **L. H. Williams,** who has been managing director since 1955. Mr. Williams is to take up a new executive appointment in Shell's International Chemical Organisation. Mr. Iliff was educated at Oundle and King's College, Cambridge, where he was a scholar in Natural Sciences. During the war he was in the Royal Engineers and reached the rank of Lt.-Col. He was mentioned in dispatches. In 1948 he joined Shell Petroleum's chemical planning group and in 1950 spent a year working in Shell's chemical plants in the U.S.A., mainly in Houston, Texas. In 1951 he returned to the U.K. and formed a long-range planning group for chemicals. From 1955 to 1958 he was with Deutsche Shell, first as chemical adviser and subsequently as manager of their newly created Chemical Industry Group. He returned to the U.K. in 1958 for a special organisational assignment in Chemical Industry Administration. In 1959 he joined Shell International Chemical Co. on its formation as regional co-ordinator (U.K., Caribbean, Central and South America, liaison with North America).

E. S. Hiscocks, M.SC., F.R.I.C., at present the director of the United Kingdom Scientific Mission in Washington, has been appointed to succeed **Dr. R. A. E. Galley** as the director of the Tropical Products Institute, D.S.I.R. Dr. Galley is resigning to take up an appointment with the Shell group as research director and manager of the Woodstock Agricultural Research Centre at Sittingbourne, Kent.

Mr. Hiscocks, who is 56, has been in the United States since 1957 and is expected to take up his new post in the autumn. He was educated at Swansea Grammar School and University College, Swansea, graduating with honours in 1924. The following year he gained his M.Sc. degree and in 1935 became a Fellow of the Royal Institute of Chemistry.

From 1926 to 1939 he served in the Department of the Government Chemist (now the Laboratory of the Government Chemist), and from 1939 to 1944 he was with the Raw Materials Department of the Ministry of Supply. In 1944 he was appointed secretary of the National Physical Laboratory. Mr. Hiscocks has made a special study of laboratory administration and in 1956 published a book under that title.

N. A. Iliff

Dr. Robert Galley, who is 50, has been director of the Tropical Products Institute since 1953. He is a leading authority on pesticides and has been a member of the World Health Organisation's expert panel on pesticides since 1949. One of the major problems which he has faced in recent years is the development of resistance by mosquito carriers of malaria to the insecticides commonly used, and he will continue active research in this field at the Woodstock Centre.

During his seven years as director of the T.P.I., Dr. Galley has made on-the-spot studies in many parts of the world, and he is particularly well known in East, Central and West Africa.

J. D. Chiswell, formerly managing director of Bayer Products Ltd. and Winthrop Products Ltd., has been appointed group advisory director—finance; **Dr. R. S. Inch,** a director of Bayer Products Ltd., Winthrop Products Ltd., and a number of the Winthrop European companies, now has wider responsibilities as director of group developments, and will be appointed to the board of Winthrop Laboratories Ltd.

C. R. B. Williamson has been elected managing director of Bayer Products Ltd. and Winthrop Products Ltd.

B. S. Smith has been appointed as head of the Isotope Research Division of A.E.R.E., Harwell. (This Division is situated mainly at the Wantage Research Laboratory at Wantage, Berkshire, a few miles from the Harwell site.)

Mr. Smith, whose appointment dates from May 17, 1960, was formerly head of Health Physics Division at the Atomic Energy Research Establishment, Harwell, and his successor in that post is **N. G. Stewart,** at present at the Authority's Dounreay Experimental Reactor Establishment. Mr. Stewart will take up his new duties on August 1, 1960.

J. B. Doyle has been appointed head of I.C.I. Central Safety Department in succession to **H. R. Payne,** who has retired.

A. R. G. Williams, managing director of National Adhesives Ltd., has been elected President of the Adhesives Manufacturers' Association. Vice-President is **J. Morris** (Samuel Jones and Co. Ltd.).

Bryan Topley has been elected deputy-chairman of Albright and Wilson Ltd. He joined the company in 1936 and was appointed a director in 1944.

Dr. Richard O. Roblin has been elected president and director of the Cyanamid European Research Institute in Geneva. Dr. Roblin, co-discoverer of the widely used sulpha drugs sulphadiazine and sulphamerazine, and vice-president for research and development of American Cyanamid Co. takes over from **Dr. R. C. Swain,** who was recently appointed director-general of Cyanamid International. Dr. Swain will continue as a director of the basic research institute.

S. L. Waide, director of the Chemicals Division of Newton Chambers and Co. Ltd., has been elected chairman of the British Disinfectant Manufacturers' Association and also chairman of the Association of Toilet Paper Manufacturers.

Dr. J. Bell, manager of the I.C.I. Nobel Division silicones department since May 1957, has been appointed to the Division Board in succession to **F. B. Wrightson**, engineering and technical director, who retired on April 30.

Dr. Bell, who is 50, joined I.C.I. in its research department at Stevenston, Ayrshire, in 1936. During the war Dr. Bell worked in the acids department, Ardeer, and in 1946 was a member of an I.C.I. mission to the U.S.A. for six months. On his return he joined the operating department, in which he became an assistant manager in 1953. A month later he was appointed acting assistant manager of Ardeer factory, Ayrshire, and in January 1954 became an assistant works manager of Ardeer, a post he held until taking charge of the silicones project.

Dr. Lester D. Apperson has been appointed director of research for the Toilet Articles Division of the Colgate-Palmolive Co.

Dr. Apperson, formerly manager of Skin and Oral Products Research, will be responsible for all scientific programmes at the company's laboratories in Jersey City leading to the develop-

ment of new products for the Toilet Articles Division. He will also supervise the studies concerned with the continuing improvement of the Division's present products.

Dr. Apperson joined the company in 1940 as a chemist in toilet articles research and then served in various supervisory capacities. When the company was divisionalised in 1957, he was appointed manager of Skin and Oral Products Research.

H. W. Palmer

Herbert William Palmer, the new president of the Association of British Pharmaceutical Industry, was born in 1907 and educated at Ealing Grammar School and the London School of Economics, where he graduated with honours in commerce. He has been managing director of Glaxo Laboratories Ltd. since 1956. Mr. Palmer, who joined Glaxo in 1928, has been concerned with many major building and plant installation projects at home and overseas, including the erection of antibiotics plants at Barnard Castle and Ulverston and of a cortisone plant at Montrose. In his early days with the company Mr. Palmer spent considerable time in Australia and Belgium. Later he travelled all over the world in connection with the development of his company's interests overseas. He is married and has four children.

David H. Conklin, European director of Du Pont's International Department, has been appointed assistant general manager of the department. **Milton H. Campbell,** assistant European director, becomes European director. **John K. Jenney** becomes assistant to the general manager of the International Department and will be concerned with all phases of the operation of the department as well as a director of a number of subsidiary companies.

R. Langford and **I. H. Phillipps** have been elected to the board of Humphreys and Glasgow Ltd.

Mr. Langford, who is 40, has been with the company since 1946. Mr. Phillipps, 35, also an associate director since 1957, joined the company in 1945.

G. Adams and **R. J. Withers** have been elected as associate directors of the company.

Approved names: a new list

A new list of approved names for drugs has been published by the British Pharmacopœia Commission, 44 Hallam Street, London, W.1, to whom all enquiries about them should be addressed.

Approved name — *Other names*

AMPHOTERICIN
Polyene antibiotics isolated from a strain of a *Streptomyces* species, referred to as *Streptomyces nodosus* (specific substances are designated by a terminal letter; thus, Amphotericin B)
Fungizone is Amphotericin B

BENZONATATE
2 - (ω - Methoxypolyethyleneoxy)ethyl *p* - butylamino-benzoate
Tessalon

BENZTHIAZIDE
3 - Benzylthiomethyl - 6 - chloro - 7 - sulphamoylbenzo - 1 : 2 : 4 - thiadiazine 1 : 1 - dioxide
Fovane

CHLORMIDAZOLE
1 - *p* - Chlorobenzyl - 2 - methylbenzimidazole

CHLORZOXAZONE
5-Chlorobenzoxazolin-2-one

CINNARIZINE
1 - *trans* - Cinnamyl - 4 - diphenylmethylpiperazine

DIETHYLPROPION
α-Diethylaminopropiophenone
Tenuate is the hydrochloride

GUANETHIDINE
1 - (2 - Guanidinoethyl)azacyclooctane
Ismelin is the sulphate

ITRAMIN TOSYLATE
2 - Nitratoethylamine toluene - *p* - sulphonate
Nilatil

METHANDIENONE
17β - Hydroxy - 17α methylandrosta - 1 : 4 - dien-3-one
Dianabol

METHDILAZINE
10 - (1 - Methyl - 3 - pyrrolidinylmethyl) phenothiazine

METRONIDAZOLE
1 - (2 - Hydroxyethyl) - 2 - methyl - 5 - nitroimidazole
Flagyl

NEALBARBITONE
5 - Allyl - 5 - neopentylbarbituric acid
Censedal: Nevental

PAROMOMYCIN
An antibiotic produced by *Streptomyces rimosus forma paromomycinus*
D - Glucosaminedeoxystreptamine D - ribosediaminohexose
Humatin is the sulphate

PHENETHICILLIN
6 - (α - Phenoxypropionamido) penicillanic acid
(1-Phenoxyethyl)penicillin
Broxil is the potassium salt

PRALIDOXIME IODIDE
Picolinaldoxime methiodide
Protopam

SODIUM IPODATE
Sodium β - (3 - dimethylaminomethylenamino - 2 : 4 : 6-tri-iodophenyl)propionate
Biloptin

SPIRONOLACTONE
β - (7α - Acetylthio - 17β - hydroxy - 3 - oxoandrost - 4-en-17α-yl)propionic acid lactone
Aldactone

SULPHINPYRAZONE
1 : 2 - Diphenyl - 4 - (2 - phenylsulphinylethyl) pyrazolidine-3 : 5-dione
Anturan

THIOPROPERAZINE
2 - Dimethylsulphamoyl - 10 - [3 - (4 - methylpiperazin - 1 - yl) - propyl]phenothiazine
Majeptil is the methanesulphonate

Proprietary name	*Approved name reference*
Aldactone	Spironolactone
Anturan	Sulphinpyrazone
Biloptin	Sodium Ipodate
Broxil	Phenethicillin
Censedal	Nealbarbitone
Dianabol	Methandienone
Flagyl	Metronidazole
Fovane	Benzthiazide
Fungizone	Amphotericin
Humatin	Paromomycin
Ismelin	Guanethidine
Majeptil	Thioproperazine
Nevental	Nealbarbitone
Nilatil	Itramin Tosylate
Protopam	Pralidoxime
Tenuate	Diethylpropion
Tessalon	Benzonatate

Dutch agents appointed

Fait-Oil N.V. of Delden have been given sole manufacturing and distributive rights for the whole of their range of products by the Reddish Chemical Co.

Antibiotics feed enquiry

Lord Netherthorpe is to be the chairman of a joint committee set up by the Agricultural and Medical Research Councils to examine the possible consequences of the feeding of antibiotics to farm animals, and to consider whether this use constitutes a danger to human or animal health.

Prof. A. A. Miles, Director of the Lister Institute of Preventive Medicine, is to take the chair of a scientific sub-committee, which will examine the evidence in detail and place its findings before the main committee.

Borrowman research award

Miss Agnes Borrowman, proprietor of the historic pharmacy of Deane and Co., Clapham Common, London, left by her will a fund to be used for furthering pharmaceutical education and research. The income has been accumulated since her death and her trustees, Sir Hugh Linstead and Dr. J. W. Fairbairn, are now inviting applications for the first award to be made under the trust deed. It is the offer of a Research Award of £500 a year for two years for research undertaken in a School of Pharmacy in Great Britain by a pharmaceutical chemist or graduate in pharmacy. Particulars of the award have been sent to all Schools of Pharmacy in Britain.

Shell's £15,000 for research in nematology

A new nematology laboratory for Imperial College, to be built and equipped at the College Field Station at Silwood Park, near Ascot, Berkshire, at a cost of £30,000, will be the first university laboratory in the Commonwealth specifically staffed and equipped for research and training in this subject at post-graduate level.

Shell International Chemical Co., because of its world-wide interest in agricultural chemicals, is contributing £15,000 towards the cost of building and equipping the laboratory which, it is hoped, will be completed in time for the new academic year beginning next October.

Nematology is the name applied to the branch of zoology which deals with free-living and parasitic roundworms. Parasitic nematodes in vertebrate animals have been studied for many years, but less attention has hitherto been paid to the nematodes parasitic in plants and invertebrate animals.

The serious economic effects of plant nematodes on agricultural production have aroused concern in recent years, not only in this country, but in the F.A.O. and among the Colombo Plan signatories.

Under Prof. B. G. Peters, who was appointed to a new Chair of Parasitology at Imperial College in 1955, work on this subject has been developing, and a full-time one-year course in nematology was started in 1958.

Bulk chemicals direct from Cumberland to Continent

Marchon Products Ltd. are developing direct delivery by road tankers of liquid chemical intermediates in bulk from Whitehaven to Continental destinations.

The Continental Ferry Service, operating from Felixstowe to Rotterdam, with regular weekly sailings, is proving an efficient and economical method of delivering large quantities of liquid in bulk to Germany, making it possible to deliver direct into the customers' premises within four to five days of the product leaving the Marchon plant in Whitehaven.

It is hoped eventually to extend the service to Italy, Austria and Switzerland.

The liquid is taken in 3,600/4,000 gallon capacity stainless steel, lagged and coiled tanks, which are mounted on articulated trailers, and conveyed by road from Whitehaven to Felixstowe, a distance of 360 miles, where the trailer is uncoupled from its tractive unit and hoisted by a giant crane into the hold of the waiting ferry ship. After a 12 hours' crossing to Rotterdam, the tank unit is hoisted out of the hold and landed on the quay, where it is fitted with the registration plates of the Continental tractive unit and conveyed to its final destination.

This door-to-door service, planned essentially to meet the demands of large bulk liquid consumers with their own storage tank installations, is operated jointly by Bulk Liquid Transport Ltd. of Gildersome, Leeds, and James Fisher and Sons Ltd., shipowners, Barrow-in-Furness.

Sponsored research

The Sondes Place Research Institute, Dorking, Surrey, which evolved from a consulting chemical and chemical engineering practice founded in London in 1936, has issued an attractive brochure outlining its services. These include information services, project assessment, laboratory research, pilot plant development, plant design and mechanical prototyping.

The Institute is one of the leading British organisations specialising in sponsored research. The Director of Research is Dr. H. H. Chambers, and among the directors are Dr. F. A. Freeth, F.R.S., formerly of I.C.I., and the Earl of Halsbury, formerly director of the National Research and Development Corporation.

Microchemical apparatus standard

The B.S.I. has published revisions of Parts B2, D3 and H1 of B.S.1428, "Microchemical apparatus," *i.e.*:

B.S.1428: Part B2, "Ammonia distillation apparatus (Markham)."
B.S.1428: Part D3, "Micro-nitrometer (Pregl type)."
B.S.1428: Part H1, "Weighing vessels for micro-chemical analysis."

Copies of these publications may be obtained from the British Standards Institution, 2 Park Street, London, W.1. B.S.1428: Parts B2 and H1 price 3s. each, Part D3 price 4s. net.

Technical Press Review—June

Automation Progress. — Machine Tool Exhibition; Control and Handling in Modern Resistance Welding; British Electric Servo Motors; Standardisation and Automation; Automation on the Railways —3; Handling, Cutting and Drying of Wood in a Sawmill; Auto Inspection Devices.

Chemical and Process Engineering. — Cryogenics Research and Engineering; Materials of Construction for Chemical Plant—Lead; Chemical Engineering Fundamentals; Design of a Solvent Extraction Plant for Phenol from Sulphite Liquors; Utilisation of Waste Sulphite; Use of Hardboard for Neutron Shielding.

Dairy Engineering.—Recent Developments in Aluminium Equipment; How Plastics Serve the Dairy Industry; Galvanised Steel for Dairy Plant and Equipment; Hints on the Care of Aluminium; Practical Cleaning Routines for the Dairy—5.

Fibres and Plastics.—Cyanoethylation of Cotton; PVC Pastes for Coated Fabrics; Impregnated Glass Cloths; Coating Machinery for PVC-coated Fabrics.

Food Manufacture. — Automation—Review of equipment for automatic process control; Walls Sausage Factory Visit; Richmond Sausage Co. Factory Visit; World Food Supplies —5, World Requirements; Lysine Fortification of Food.

Paint Manufacture. — Polyester Resins in Wood Finishes; Paint Industries of the Outer Seven; Advanced Paint Chemistry—10; Papers presented at the Association of Printing Technologists' Conference.

Petroleum.—Instrumentation for Continuous Control and Analysis; Automatic Control with High Speed Chromatography; Oilfields and Crudes of the United Arab Republic —1.

World Crops.—The Quelea Bird; Coffee Leaf Rust Disease; Insect Pests of Coconut Palm in India; The Dancing Daisies—Pyrethrum cultivation in East Africa.

Corrosion Technology. — Corrosion of Collapsible Aluminium Tubes; Assessment of Paint Durability—Accelerated Weathering versus External Exposure; Corrosion Inhibitors for Aluminium in Acid Solutions.

For specimen copies and subscription forms apply to the Circulation Manager, Leonard Hill House, Eden Street, London, N.W.1.

MEETINGS

Society for Analytical Chemistry

July 14-15. Symposium on "Analytical Aspects of Agricultural Chemistry." Nottingham University.

Chemical Society

July 12-14. Symposium on "Physical, Chemical, and Biological Methods in the Study of High Molecular Weight Carbohydrates." The Edinburgh and East of Scotland College of Agriculture, West Mains Rd., Edinburgh 9.

Society for Applied Bacteriology

July 4-7. Annual Meeting and Summer Conference. Neuadd Reichel, University College of North Wales, Bangor. Symposium sessions on *Pseudomonas* and *Achromobacter*.

The National Hospital

June 19-25. Centenary celebrations. The National Hospital, Queen Square, London, W.C.1. Lectures include "Batten and the Developments and Future of Research into Poliomyelitis," by Dr. John Marshall.

Disinfectant production increased

I.C.I. are stepping up production of *Topane* and *Topane* WS, their brands of ortho-phenylphenol and sodium ortho-phenylphenate disinfectants and preservatives.

Considerably increased Topane production and the commissioning of a new plant for Topane WS are being made possible by I.C.I's expanding production of phenol.

Topane and Topane WS are said to be efficient at economically low concentrations and are practically odourless. Topane can be applied by solution in organic solvents and in animal and vegetable oils, whilst Topane WS, the sodium salt, is complementary in that it is highly soluble in water.

Typical applications for these chemicals are the prevention of rot and sapstain in timber, "red heat" in leather, fungal attack in fruit and vegetables, and of mould and rot in building products and textiles, including rope. Other users are the paint, paper, cosmetic, pharmaceutical, disinfectant and adhesive industries.

New compound fertilisers

A new concentrated compound fertiliser, *Shell No.1* is now being marketed in the U.K. market by Shell Chemical Co. Ltd. This entry into the compound fertiliser market follows the sale by the company during the past four years, of their nitrogenous fertiliser, *Nitra-Shell*.

The analysis of the new compound is 17% N, 11% P_2O_5, 22% K_2O, which gives a total of 50% plant nutrients. The selling price of the fertiliser is £37 13s. per gross ton in 6-ton lots delivered to the nearest station.

A.B.P.I. annual report

The annual report and year book 1959-60 of the Association of British Pharmaceutical Industry reviews the discussions with the Ministry of Health and the Department of Health for Scotland regarding the recommendations of the two committees on the cost of prescribing.

The existing voluntary price regulation scheme ends this month (June) and negotiations with the Ministry of Health for its continuation are proceeding. The full text of a statement sent to M.P.s on February 27 regarding the Report of the Comptroller and Auditor-General on the Civil Appropriation Accounts (Classes I-V) for 1958-59 is given. A statement of labelling principles for use in the provision of supplies to hospitals has been drafted by a special committee of the Association and circulated to all members.

The Association has accepted an invitation to submit evidence to the Working Party set up to review pharmaceutical legislation.

U.K. exports of drugs and medicines in 1959 reached the peak figure of £40·1 million, the principal customers being Australia (£4 million) and Nigeria (£2·6 million). Short notes on the various export markets are given in the report together with an account of relations with the members of the European Free Trade Association with special reference to their Pharmaceutical Industries Association. Observers have also been sent to meetings of the Groupement International de l'Industrie Pharmaceutique set up by the European Economic Community.

The Association has given assistance in the preparation of forthcoming issues of the British Pharmacopœia, the British Pharmaceutical Codex and the British Veterinary Codex.

The Report includes statistical tables on production and employment, exports and imports, National Health Service prescriptions and expenditure and wholesale price index numbers. A full list of members concludes the report.

---

50 years of chemical plant

On June 10 the A.P.V. Co. Ltd. celebrates the fiftieth anniversary of its foundation. The company was started in Wandsworth, London, in 1910 by Dr. Richard Seligman, as the Aluminium Plant and Vessel Co. Ltd., to develop commercially a patent for the welding of aluminium. It was the first company to produce large vessels in aluminium, as the industrial application of this metal had previously been handicapped by the difficulty in welding.

The subsequent development of welded fabrication in aluminium, and later in stainless steel, the invention of the Paraflow plate heat exchanger in 1923, and the growth of the company as process engineers, built the A.P.V. Co. up as one of the leading manufacturers of process plant.

Today the company employs nearly 2,000 people in its new factory at Crawley, Sussex, and it has created a large overseas organisation based on eight associated companies, four with their own factories.

Dr. Seligman, although now retired from the chairmanship, is still with the company today as president.

Chemical engineering scholarships

Constructors John Brown Ltd. have entered into an agreement with the Institution of Chemical Engineers for the award of two scholarships to encourage research in chemical engineering and, in particular, in chemical plant design.

The scholarships are tenable at any educational institution in the U.K. in receipt of grants from the University Grants Committee, and having a department of chemical engineering under the direction of a professor of chemical engineering.

Anti-dumping duty

The Board of Trade have had under investigation an application for the imposition of anti-dumping duties on ammonium sulphate (other than analytical reagent quality) imported from Western Germany, and Belgium. The circumstances have been examined and the Board are satisfied that dumping has been taking place and that this threatens material injury to the United Kingdom industry.

The Board now announce that the German and Belgian manufacturers concerned have agreed to raise their export prices forthwith. The Board are therefore taking no further action on the application.

Alloa Glass Ltd.

The Alloa Glass Work Co. Ltd., Alloa, Clackmannanshire, has changed its name to Alloa Glass Ltd.

Founded in 1750 by Lady Frances Erskine and now an important member of the United Glass Group, the glassworks produce all types of glass containers in all common colours.

Visit of Iranian ambassador

The Iranian ambassador, His Excellency H. Ghods-Nakhai, G.C.V.O., paid a visit to the Ware factory of Allen and Hanburys Ltd. on May 13.

During the tour after lunch he was shown many of the products that will be manufactured in the factory now being built near Teheran by the "Darou Pakhsh" Welfare Organisation in co-operation with Allen and Hanburys Ltd.

Price reduction

The price of *Hydroderm*, made by Merck, Sharp and Dohme Ltd. has been reduced. New prices are: 5G. tubes, list price 9s., trade price 6s., 15G. tubes, list price 22s. 6d., trade price 15s.

Aspro end clock-punching

Clock-punching has been abolished at the Aspro-Nicholas factory in Slough, where 700 workers have been put on trust to keep good time. After a three months' trial clocking on and off has now been finally ended.

The experiment has improved attendance and punctuality. The success achieved has prompted the company to remove the distinction between workers and employees generally labelled "staff." At the same time working hours have been reduced from 45 hr. a week to 42½ without pay reduction.

"Unseen Enemies"

In many parts of the world inherently beautiful and productive, the pitiful effects of infectious diseases are too often seen: leprosy, yaws, trachoma, malaria and many others. The microscope reveals the cause of these diseases bacteria and viruses, invisible to the naked eye, present in unimaginable numbers in all the places where people live and work. These harmful agents are passed from one person to another in many ways; often they are carried by insects. So the diseases spread.

Their effects can often be cured or alleviated by medical means such as vaccination or the use of antibiotics. Their transmission may be halted by destroying the vectors with the systematic application of insecticides. But the most energetic medical programme cannot unaided remove the threat of disease and the economic ills associated with it. What is needed is an attack on the living conditions in which diseases flourish: dirt, overcrowding, polluted air and water. The problem therefore is a social one, in which industry, economics and education must be associated with medicine, if conditions of healthy living are to be ensured.

Unseen Enemies, a new colour film made by the Shell Film Unit, illustrates the present position with photographic sequences taken in many parts of the world. Its aim is to draw attention to the need for social planning to support medical progress in the prevention of communicable disease. Though Shell are directly concerned in the production of chemicals used in the campaign against disease-carrying insects, the film is primarily intended to reflect the Group's interest, as an international enterprise, in the means of raising living standards.

The film was made with the active support of the World Health Organisation and with much local co-operation in the following countries: India, Sarawak, Brunei, Thailand, Spain, Switzerland, Turkey, the United Kingdom, Nigeria, Senegal, Sudan, the Republic of the Upper Volta, Brazil, Colombia, Guatemala and Mexico. It runs for 31½ min. and can be borrowed in several language versions from Shell and the Petroleum Films Bureau, 29 New Bond Street, London, W.1.

News from Abroad

SOVIET UNION

Cheaper medicines

On April 1 state retail prices of medicines in the Soviet Union were cut by an average of 14%. Penicillin, terramycin, syntomycin and other antibiotics are from 31 to 57% cheaper.

The prices of certain sulpha drugs and vitamins have been halved and prices of a number of other medicines have also been reduced.

This is the third and biggest reduction in medicine prices in the Soviet Union in the past five years.

Since their budget allocations have remained unchanged, hospitals will receive the equivalent of another 400 million roubles for the purchase of medicines as a result of the new price cuts.

KENYA

Improved pyrethrum

Two new varieties of pyrethrum with a high insecticidal content have been developed at the Kenya Government's agricultural research station at Molo, 8,250 ft. up in the White Highlands.

Doctor Ulrich Kroll, the Senior Pyrethrum Officer in the Department of Agriculture, who is in charge of the Molo station, has been working on the development of new strains there for 15 years.

Of his two latest varieties C45 will produce flowers containing more than 1·7% pyrethrins between 7,000 and 8,500 ft. above sea level, and M31 about 1·6% between 7,000 and 9,000 ft.

These strains, with many others suited to various conditions, are sold to local farmers in the form of seed or "splits," a service which is increasingly popular.

The total output of seed at Molo has increased from 2,032 lb. in 1958 to 5,234 lb. during last year.

GHANA

New May & Baker Branch

In the presence of some 150 guests, a new branch of May and Baker Ltd. was opened at Tema on May 4 by the Minister of Health, The Hon. Imoru Egala.

The Minister recalled that the M. & B. organisation was known throughout the world, principally for its pioneer work in the development of important medical products. He also mentioned M. & B. research into agricultural and veterinary problems.

Mr. E. V. Thomas, director of May and Baker Ltd., who flew out from England to attend the opening, thanked the Minister. He referred to the close association that had already developed between his company and the medical, scientific and business worlds of Ghana through the work of Mr. Archibong and others of their associated company, May and Baker (West Africa) Ltd.

GERMANY

Increased chemical turnover

The West German chemical industry (including high-grade coal derivatives) marketed goods during 1959 to a value of approximately DM. 20,500 million, or almost 14% more than the preceding year, according to Barclays Bank D.C.O.'s branch in Hamburg, quoting local sources.

In terms of turnover this secures second place within German industry, exceeded only by the machine building industry. As in the previous year, roughly a quarter of the total turnover was accounted for by exports.

Erdölchemie expand

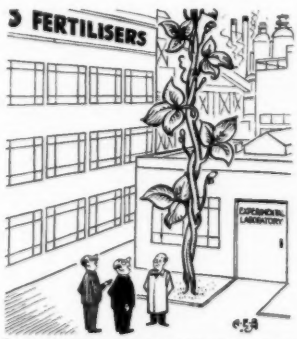
The second stage of the new petroleum chemicals production plant of Erdölchemie G.m.b.H. at Dormagen, near Cologne, Western Germany, is now being commissioned.

Erdölchemie, in which BP's German associate and Farbenfabriken Bayer A.G. each have a 50% interest, completed the initial stage of its construction during 1959, and the company's first four processing units have now been operating for 12 months.

The units now being commissioned include a cracking and gas separation plant, which is designed to treble Erdölchemie's previous output of ethylene.

The ethylene using units now going into service include an ethanol (synthetic alcohol) plant, and a second plant for producing ethylene oxide, which is used, among other things, in the manufacture of glycols.

One of the units recently successfully commissioned by Erdölchemie is a hydrotreater, which removes gum forming material from the gasoline produced as a by-product by the ethylene units. This plant, which was developed and designed by BP, is believed to be the first commercial sized one of its kind for treating steam-cracked gasoline.



"WELL, YOU CERTAINLY SEEM TO HAVE HIT ON SOMETHING THERE, JACK"

Cosmetic chemists to meet

The first Congress of Cosmetic Chemistry sponsored by the International Federation of Societies of Cosmetic Chemists will be held in Munich from August 31 to September 3. British contributors to the provisional lecture programme are A. Herzka on "Aerosols" and Dr. R. H. Marriott on "Consumer research on new products." Other contributions will come from Switzerland and France. The programme includes a banquet and a trip to the Bavarian Alps and there is a separate ladies' programme.

The Congress membership is DM 50 and guest tickets cost DM 30 each. Applications should be sent to Dr. Bruno Storp, München-Solln, Bertelestr. 75, Germany.

UNITED STATES

New essential oil factory

Schimmel and Co. Inc. is moving its office and plant to Newburgh, New York, where the company's new building has just been completed.

Schimmel has been at 601 West 26th Street in New York City ever since it was established in 1934 as a subsidiary of the German essential oil firm of Schimmel & Co. A.G. at Miltitz bei Leipzig, now a state-run enterprise behind the iron curtain.

Gert Keller, who established the American company for the German firm and who together with B. G. Wirsing is the present owner of Schimmel and Co. Inc., states that the new plant with its additional modern facilities for manufacturing, compounding and development work will enable the company to serve its customers more fully and efficiently. The location was chosen for its quick and convenient access to the greater New York area and for the increased space for expansion.

Hooker to make sodium hexametaphosphate

Construction of facilities to manufacture sodium hexametaphosphate will be undertaken almost immediately by the Phosphorus Division of Hooker Chemical Corp. The installation, expected to be completed by December 1960, will be located at Jeffersonville, Ind., headquarters for the division's four plants.

Sodium hexametaphosphate has been a commercial product for some 30 years. It is extensively used in the preparation of boiler compounds, for industrial and municipal water treatment to soften water and prevent scale formation, for dishwashing and detergent compounds, for conditioning oil drilling muds, and in the manufacture and processing of paper, textiles and leather.

Construction of the hexametaphosphate facilities will proceed simul-

taneously with another plant now being built at Jeffersonville for the manufacture of tetrapotassium pyrophosphate, to be completed in the autumn.

Elemental phosphorus, the key raw material, is manufactured by Hooker at Columbia, Tenn., and Niagara Falls, N.Y. The company is to increase phosphorus capacity by building a third phosphorus furnace at Columbia. Engineering design and purchase of materials for this project are both well advanced and construction will commence soon.

Chromatography development

A new method for collecting fractions from a gas chromatograph directly in ultra-micro infra-red absorption cells has been introduced by Connecticut Instrument Corpn. Samples as small as 1 microlitre or less can be trapped in the cavity type cell directly and then transferred to the infra-red spectrometer for analysis.

AUSTRALIA

Fungus kills mosquitoes

Experiments by the World Health Organisation to eradicate mosquitoes in the south-west Pacific have followed a discovery made by Australian and New Zealand medical scientists.

A United Nations expert, Mr. J. W. Wright, said in Sydney that the discovery had opened a promising new line of attack against mosquitoes carrying the disease of elephantiasis. The discovery was made by an Australian, Dr. Collis, and a New Zealander, Dr. Marshal Laird, while working in Malaya. They have found a water fungus which has the effect of arresting the life cycle of certain types of mosquitoes. Field trials on a group of three atolls near New Zealand have given extremely promising results.

Mr. Wright said the fungus grew and spread and, while establishing itself, attached to the larvæ of mosquitoes and killed them off. This offered an answer to the problem of the mosquito developing its own resistance to present insecticides. Success against the mosquito would remove the threat of malaria from 500 million people, and help to prevent tens of millions of illnesses each year.

More soda ash

The enlarged plant of I.C.I. of Australia and New Zealand Ltd. at Osborne, South Australia, will increase the company's output of soda ash by some 30%, and the output of all the factory's products to some 160,000 tons a year.

Caustic and chlorine plant

A new caustic and chlorine plant, to operate in conjunction with a salt works, is to be built at Port Stephens, New South Wales, by Pacific Salt Ltd. This company is spending £320,000 on a packaged German plant which is expected to be in operation in 18 months.

Sodium cyclamate

The Australian Excise Tariff is being amended to facilitate the establishment of a new industry in Australia, the manufacture of sodium cyclamate, and to permit its delivery free from excise duty when it is used for medicinal purposes. A complementary amendment is to be made to the Customs Tariff.

Anti-corrosion chemicals

The manufacture of Gamlen chemicals and solvents in Australia is being expanded by Gibson Battle (Melbourne) Pty. Ltd. These products are made in Australia under licence to Gamlen Chemical Co. of U.S.A., makers of combustion additives to combat sulphur and vanadium corrosion of internal surfaces of boilers.

SOUTH AFRICA

Nicholas factory

Nearly 200,000 sq. ft. of the 22-acre site purchased in Pinetown, Natal, by Nicholas Products (Pty.) Ltd. has been cleared for the erection of a factory that in the beginning will occupy 63,000 sq. ft., and will later be extended. This first investment will take about £250,000. The factory is to be equipped for the manufacture of *Aspro* and the Nicholas range of veterinary, ethical and domestic products. The factory will be air-conditioned, with acoustics control to promote the smooth flow of production. Particular attention is being paid to the recreational needs of workers.

Drug prices criticised

At a meeting of the South African Medical and Dental Council in Cape Town, the Dean of the Faculty of Medicine at the University of the Witwatersrand said that patients could be saved a great deal of money if doctors prescribed the chemical names of drugs rather than the trade names. He said that South Africa was "the happy hunting ground of therapeutic firms throughout the world." The cost to the public of many drugs, similar in chemical properties but with differing trade names, varied widely. "If doctors in their prescriptions used the chemical terms rather than the trade names the chemists would soon get used to these terms and have no difficulty in supplying them at far less cost to the patients concerned." The Union's health authorities should follow the lead given in a recent issue of an important American publication, which provided the chemical names for a long list of trade names of drugs. But a doctor wondered whether it was true that chemists would soon accustom themselves to the chemical terms for some drugs. "How about this one, for instance? 4,4 - dipthenyl - 6 - dimethylaminoheptanone - 3."

A doctor who said he has been associated with the South African Railways and Harbours Sick Fund for many years said that the cost of medicines, drugs and dressings provided by the fund for its 126,000 members had increased by more than £100,000 in the last year. "This was largely due to the high cost of many of the expensive trade name drugs prescribed by the fund's doctors, who were allowed 'a fairly free hand' in their prescriptions for railway patients. The Railway Sick Fund is second to none. Its operational costs have risen by more than £40,000 each year for several years past." He quoted the price of a certain type of capsule, identical in its chemical constituents but with differing trade names, which varied between 25s. and 70s. a 100.

Smith and Nephew factory

An unusual ceremony took place recently at the 250,000 sq. ft. site of the £500,000 surgical dressings factory to be erected for Smith and Nephew Ltd. at Pinetown, near Durban, Natal.

A steel casket containing products manufactured by the company, pictures of beauty queens, newspapers, coins, clothing, plastic articles, books and a scroll signed by members of the staff, was lowered into a vault in the foundations of the building.

Mr. H. S. Dagger, managing director of Smith and Nephew Ltd., who presided at the occasion, announced that the factory is scheduled to be completed in August this year with the use of up-to-date prefabrication methods.

First of its kind in South Africa, it will make white bandages, surgical gauze, lint and various surgical textiles. It will spin, weave and bleach South African raw cotton, and will not need to buy supplies from overseas. It will thus lessen South Africa's dependence on other countries for these types of goods. The factory will be on the largest levelled area in Natal Province, and £10,000 was spent on the site levelling alone.

THE CHEMICAL MARKET

LONDON.—**Acetone** is down by £4-8 ton depending on quantity. 5 gal. drums cost £124 ton and 40-50 gal. drums in 10 ton lots £80. **Silver nitrate** in 500 g. quantities is up from 5s. 1$\frac{11}{12}$d. to 5s. 1$\frac{3}{4}$d. oz. **Palm kernel oil,** refined, deodorised, 2-ton lots, naked ex-works, has risen by £1 to £136 ton. **Palm oil,** refined, deodorised, 2-ton lots, naked ex-works, is down by £1 to £101 ton.

Changes in **gums and waxes** include: Agar Agar No. 1, Kobe strip up by 3d. to 15s. 9d. lb.; Beeswax, Dar-es-Salaam spot (nominal) up by 10s. to £26 10s. cwt.; Candelilla spot up from £23 15s. cwt. to £25; Carnauba prime, spot down by 10s. to £44 cwt., and fatty grey up by 5s. to £30 cwt.; Karaya powder, spot down from 3s. 8d. to 3s. 2d. lb.; Peru balsam up by 3d. to 10s. 3d. lb.; Tragacanth No. 1 Spot and No. 2 Spot down by £1 to £139 cwt. and by £2 to £120 cwt. respectively.

New Products

Migraine treatment

The Distillers Co. (Biochemicals) Ltd. has introduced *Valgraine* tablets which combine ergotamine tartrate with *Distaval* brand of thalidomide, a non-barbiturate sedative. The product is indicated in the treatment of migraine; ergotamine relieves the characteristic headache of migraine, while the *Distaval* content enables the patient to obtain rest until the more distressing symptoms have been relieved.

Each sugar-coated tablet contains 1 mg. ergotamine tartrate B.P. and 12·5 mg. *Distaval* thalidomide.

Packs and prices are as follows:

A tube of 12 costs 6s. 10½d. (trade price 4s. 7d.) and a bottle of 100, 30s. 7½d. (33s. 9d.). There is no Purchase Tax.

Penicillinase

Burroughs Wellcome and Co. have issued the purified enzyme *Neutrapen* brand penicillinase, for use in the treatment of penicillin reactions. Present methods of treating such reactions may provide no more than transient remission because the allergen remains unaffected. *Neutrapen*, which is administered intramuscularly, is an adjunct to customary measures such as adrenaline or hydrocortisone. It destroys the penicillin itself, interfering with the antigen-antibody reaction responsible for any manifestations and thus preventing their recurrence.

The product, a freeze-dried powder for reconstitution with sterile water immediately before use, is available in rubber-capped vials each containing 800,000 units at a price of 45s. each, subject. *Neutrapen* is the trade mark of Schenlabs Pharmaceuticals Inc., U.S. Registered users Burroughs Wellcome and Co.

Weed killer in one-acre packs

That spraying costs can be cut substantially is the claim made for a new selective weedkiller, to be marketed in one-acre packs to eliminate handling of bulky drums and make possible accurate estimating of spray requirements.

Weedone LV 4 is described as having low volatility, non-poisonous and effective, at low cost, against three obstinate weeds—knotgrass, redshank and poppy—that are not killed by the normal type of MCPA. Mr. Joseph Nickerson, head of the Grimsby specialist seeds firm which is distributing *Weedone LV 4*, said that it is five times more concentrated than comparable weedkillers.

Resin-removing cream

Synthetic resins and glues are being used increasingly in industry. Workers find that they adhere tenaciously to the skin and are difficult to remove from the hands after work. To overcome this problem Rozalex Ltd. have introduced a resin-removing cream. This is claimed to remove epoxide, urea/formaldehyde, polyester, polyamide, phenol/formaldehyde, polysulphide, silicone and other synthetic resins from the skin. The cream is rubbed thoroughly over the contaminated area until the resin is loosened and then wiped off with a clean cloth, or washed off with water.

Timber preservative

In a lecture given to the Industrial Pest Control Association, Mr. D. Boocock, technical director of Standardised Disinfectants Co. Ltd., described a new technique originally developed in the United States for eradicating rot, woodworm and termites from infested timber.

The technique depends on a new type of preservative in the form of a thick mayonnaise type emulsion which, although applied to the surface of the timber, nevertheless penetrates deeply and in quantity. This enables preservative to penetrate to the seat of the infestation and to leave behind sufficient preservative to ensure long-term protection from reinfestation.

The new preservative is applied to the surface of the timber as bands and equipment for application has been developed. The process is as simple as spraying and one application of the new preservative emulsion is said to be equivalent to at least 20 brush or spray applications.

Laboratory experiments and field trials with the new technique were described in the lecture.

The new preservative is now available in the United Kingdom and Commonwealth for professional evaluation.

Floor polish resin

What is said to be an entirely new type of floor polish resin will soon be available in the U.K. It is based on a special vinyl plastic in emulsion form and is called *National 37-270*. The new polish will provide a high gloss and will be easy to apply. It is said to be scuff-resistant and non-yellowing.

Suppliers are National Adhesives Ltd.

Rot-proofing chemicals

Armour Hess Chemicals Ltd., who produce and market cationic chemicals such as fatty amines and quaternary ammonium compounds, announce novel compounds derived from their *Duomeens*, which are diamines of the general formula $RNH\ C_3H_6NH_2$, where R represents a fatty acid radical derived from tallow, coco or other natural fat. The new compounds are especially useful for preventing rot in cotton, hemp, wood, cord, leather, etc.

The diamine is reacted in a 1 : 1 molar ratio with a bivalent metal salt such as mercury, zinc or copper chloride; any bivalent metal can be used and the anion may be a bromide, sulphate, propionate, acetate or other. The diamine acts as a chelating group and forms a 6-membered ring structure with the metal. The metal atom is bound into the ring structure by co-ordination linkages of the Wernher type. These compounds are believed to be true molecular complexes. They resist cleavage well, which characteristic is inherent in the 6-membered ring configuration. Preparation of these compounds is relatively simple and is carried out in the presence of a solvent.

FERTILISERS

(*Continued from page* 260)

Zinc

Zinc has been discussed, not *per se* as a nutrient, but as an additive to compound fertilisers.[9] When zinc sulphate monohydrate is used as an ingredient, in order to deal with zinc deficiencies, the risk of fertiliser caking is increased, notably for mixtures high in phosphate and potash. There is a reduction in the solubility of the added zinc salt if ammoniated superphosphate is used in the mix, and this reduces the caking tendency. Other sources of zinc were preferable—$ZnSO_4,7H_2O$; $ZnSO_4,4Zn(OH)_2$; zinc acetate; zinc ammonium phosphate; and some chelated zinc compounds. It might be thought that the correct solution is to manufacture a zinc-fortified compound in granular form, thus obviating the caking hazard. This may not be practicable, however; zinc-fortified compounds will be specially rather than widely required (except perhaps in the generally zinc-deficient areas of Australia) and powder production is far more adjustable for batch manufacture than is granular production.

REFERENCES

1. " Fertiliser Report and Statistics, 1959," 1960, pp. 36, published by The Fertiliser Manufacturers' Association Ltd., 44 Russell Square, London, W.C.1.
2. A. L. Mehring, *Commercial Fertiliser*, 1960, **100,** (2), 23.
3. *Hardware Trade J.*, 1960, **256,** 116.
4. *Fertilisers & F-Stuffs J.*, 1960, **52,** 311.
5. K. Simpson, *J. Sci. Food & Agric.*, 1960, **11,** 71.
6. B. Wilkinson, *J. Sci. Food & Agric.*, 1960, **11,** 79.
7. H. R. Jameson, *J. Agric Sci.*, 1959, **53,** 333.
8. *Agric. Chemicals*, 1960, **15,** (3), 46.
9. J. H. Caro, H. P. Freeman and J. H. L. Marshall, *Ibid.*, 1960, **15,** (1), 34.

NEW TRADE MARKS

APPLICATIONS

Cosmetic and toilet preparations

BRONNLEY LOVE IN IDLENESS.—793,765. *H. Bronnley and Co. Ltd.*

GRASSAROME.—791,802. *Lautier Fils Ltd.*

BALM ARGENTA.—B793,452. *Oscar Moenich and Co. Ltd.*

CUDDLES.—796,032. *Co-operative Wholesale Society Ltd.*

CUDDLY.—796,033. *Co-operative Wholesale Society Ltd.*

DON LOPER.—B794,037. *Don Loper Inc.*

LIPQUICK.—794,412. LIP QUICK.—794,413. *Richard Hudnut.*

CLYNOL FASHION TONE.—794,605. *Clynol Ltd.*

CONTECT.—B795,909. *Audley Bowdler Williamson.*

Pharmaceuticals

LIXITA.—793,033. *Aspro-Nicholas Ltd.*

INJAX.—794,565. *Cooper, McDougall and Robertson Ltd.*

ORADEXON ORGANON. — 794,981. *Organon Laboratories Ltd.*

PERSANTIN. — 777,741. *Dr. Karl Thomae G.m.b.H.*

REVLON ROLL-ON.—785,577. *Revlon Inc.*

CALFIX.—791,107. *Crookes Laboratories Ltd.*

LIPOSTABIL.—791,186. *Aspro-Nicholas Ltd.*

DETROXIN.—791,768. *Glaxo Laboratories Ltd.*

GRASSAROME.—791,803. *Lautier Fils Ltd.*

ANSEPS.—791,990. *Smith Kendon Ltd.*

RESPROGEN.—792,746. *Parke, Davis and Co.*

MEKOS.—793,225. *H. Lundbeck and Co.*

PEKK.—B793,648. *Crown Chemical Co. Ltd.*

NEUTRATE.—794,867. *British Drug Houses Ltd.*

IODOVET.—795,141. *Evans Medical Ltd.*

PRODIETON.—795,704. *The Nestlé Co. Ltd.*

VERNADONIN.—796,182. *A/B Astra Apotekarnes Kemiska Fabriker.*

NEW PATENTS

COMPLETE SPECIFICATIONS ACCEPTED

Agricultural chemicals

Preparation of 2,3,5,6-tetrachlorobenzoyl halides and their derivatives, particularly for the production of herbicidal compositions. *Hooker Electrochemical Co.* 833,218.

Antibiotics

Phenoxymethylpenicillin manufacture. *Imperial Chemical Industries Ltd.* 833,060.

Dyestuffs

Phenthiazine derivatives and processes for their preparation. *Soc. des Usines Chimiques Rhône-poulenc.* 831,920.

Monoazo dyestuffs containing sulphonic acid-(sulphonyl)-amide groups. *Farbenfabriken Bayer A.G.* 831,840.

Reaction products of complex metal compounds of mono-azo-dyestuffs with basic dyestuffs and process for their manufacture. *Ciba Ltd.* 832,206.

Brightening agents comprising axylpyrazolines. *Farbenfabrik Bayer A.G.* 832,239.

Mono-azo dyestuffs containing amidino groups. *Farbenfabriken Bayer A.G.* 832,285.

Monoazo dyestuffs of the benzene-azo-naphthalene series and their use. *J. R. Geigy A.G.* 831,843.

Anthraquinone vat dyestuffs and process for their manufacture. *Ciba Ltd.* 831,880.

Water-insoluble monazo triazine dyestuffs. *Imperial Chemical Industries Ltd.* 833,396.

Blue disperse dyestuffs of the anthraquinone series. *Sandoz Ltd.* 833,132.

Pharmaceuticals

Analgesic compositions. *A. and G. Nicholas Ltd.* 831,873.

Preparation of adrenocorticotrophin. *Armour and Co.* 832,241.

Anæsthetics. *Olin Mathieson Chemical Corporation.* 831,860.

Antacid preparation and process for making same. *Bristol-Myers Co.* 831,897.

New patents are from the *Journal of Patents*, and new trade marks are from the *Trade Marks Journal*. In each case permission to publish has been given by the controller of Her Majesty's Stationery Office. Each of the publications mentioned is obtainable from the Patent Office, 26 Southampton Buildings, London, W.C.2.

Suspensions of drugs destined for injection and process for the preparation thereof. *Organon Laboratories Ltd.* 831,907.

Sulphonamide compounds and preparation thereof. *Sterling Drug Inc.* 831,919.

Production of β-ionone. *Glaxo Laboratories Ltd.* 833,088.

Therapeutic compositions and preparation thereof. *C. Pfizer and Co. Inc.* 833,029.

Preparation of heterocyclic sulphonamides. *Omikron-Gagliardi Soc. di Fatto.* 833,049.

NEW COMPANIES

These particulars of new companies have been extracted from the daily register of Jordan and Sons Ltd., company registration agents, Chancery Lane, London, W.C.2.

Manor Park Chemists Ltd. 4.2.60. 725 Romford Rd., Manor Park, London, E.12. £100. Dirs.: Rachel and Ida Turgiel.

Thorne Chemicals Ltd. 5.2.60. 15 Commercial St., Pontypool, Mon. To take over bus. of a supplier of agricultural spray chemicals cd. on at Pontypool by N. W. J. Thorne as "Thorne Chemicals" etc. £500. Perm. Dirs.: N. W. J. and Mrs. D. M. Thorne, Glenside, Pontynewynydd, Pontypool.

W. C. P. Ltd. 21.1.60. 54 High St., Stroud, Glos. To take over bus. of mnfg. chemists, etc., cd. on as "Waters' Commercial Products" at Niagara Works, Back Lane, Stroud, Glos, by J. D. Waters, etc. £10,000. Perm. Dirs.: Jack D. Waters and George H. Bullock,

L. Christian Ltd. 25.1.60. 20 Kingsway, West Wickham, Kent. Pharmacy and drug store proprs., etc. £100. Dirs.: L. S. D., Pearl L., and V. G. Christian.

Reesons Ltd. 26.1.60. Mfg., analytical, consulting, pharmaceutical and genl. chemists and druggists. £13,500. Dirs: Mrs. S. M. Reeson, 245 Upton Road, Bexley, Kent., H. G. T. Starkey, and J. L. D. McIntosh.

Epson Chemists Ltd. 27.1.60. 4 Gladstone Parade, London N.W.2. To cy. on bus. of mnfrs. of and dlrs. in chemicals, etc. £2,500. Dirs: S. Epson, Lionel Learner, Eric Epson and M. G. Abrahamson.

L. and C. Calvert (Chemists) Ltd. 19.2.60. 10 Clarendon Rd., Leeds. £500. Dirs.: Leslie and Mrs. C. Calvert.

Manufacturing Chemist's **ENQUIRY BUREAU**

Leonard Hill House, Eden Street, London, N.W.1.

Subscribers requiring names of suppliers of chemicals or plant should state their needs on this form, giving approximate quantities, clip it to their business noteheading and send it to the Bureau, as above. Please type or use block letters.

_____

_____

_____

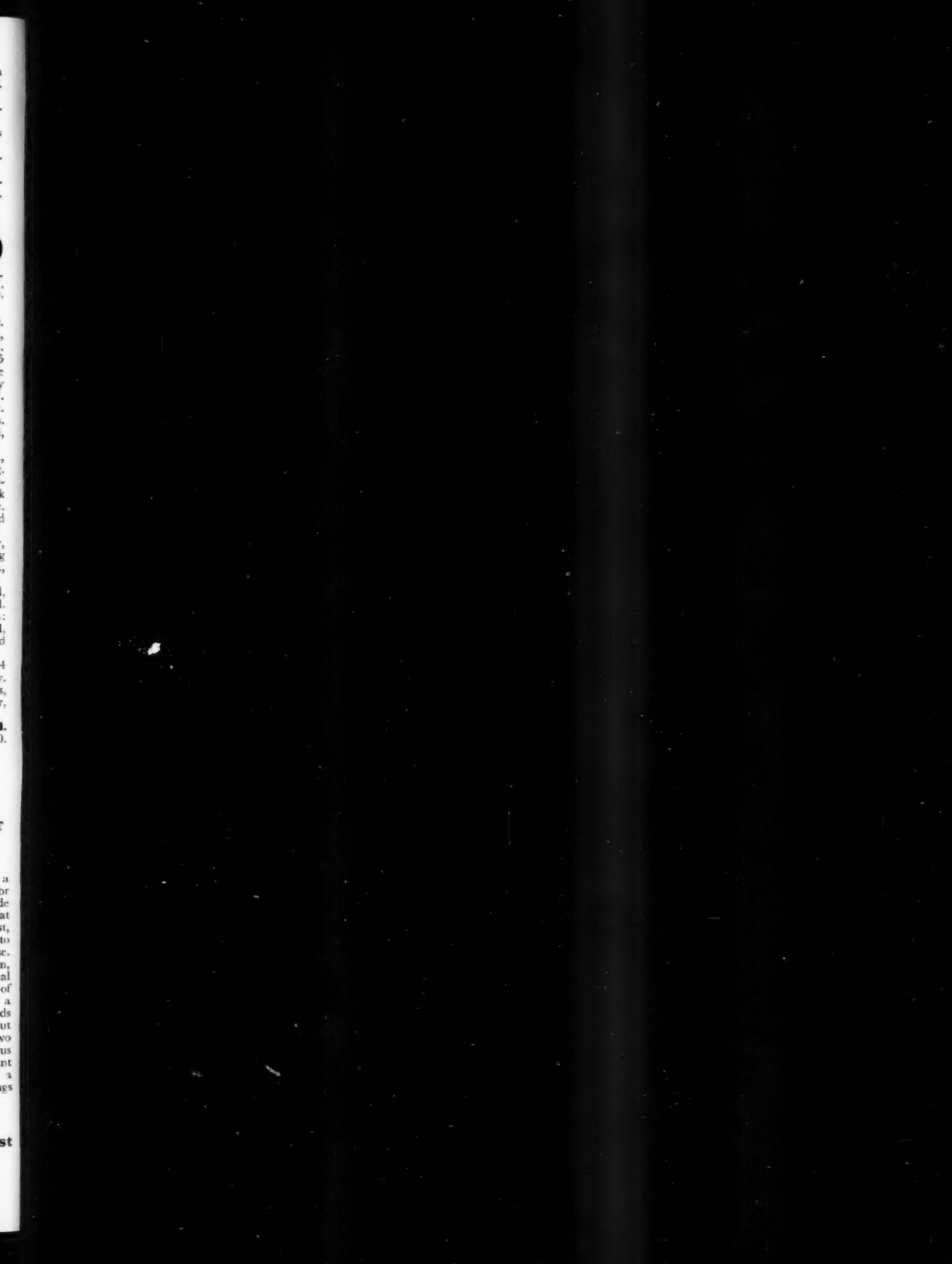
_____

_____

For office use. *No.* *Date.*

Sixty-Five Years Ago

From MANUFACTURING CHEMIST June 1895

Strawberries as a Medicine

Strawberries have for a long time had a well-established reputation as a remedy for the gout. Dr. A. George, in the Annales de la Société Horticole de l'Aube, tells us that in the last Century the great botanist, Linnæus, who was gouty, had much cause to extol the action of the fruit in this disease. At this epoch, when uric acid was unknown, he had the prescience that the chemical cause of gout was identical with that of gravel, and he expressed himself in a picturesque manner to one of his friends when he wrote to him: "I have the gout and you have gravel; we have married two sisters." The only method that Linnæus found of easing his gout was by an abundant use of this fruit, to which he has made a graceful acknowledgement in his writings (*Science Siftings*).